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THE AFRICAN BAOBAB.

(ADANSONIA DIGITATA, L.)

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(*With a Coloured Plate.*)

THOUGH the Baobab is not a new discovery, there are so many peculiarities attached to it and to its Australian relative, that we are led to believe some description of these trees will not be without interest to the readers of THE STUDENT. We therefore intend to devote two papers to their consideration, and these will be the more acceptable from the introduction of the numerous notes which my friend Mr. Baines has furnished me with, on the localities where he has seen and sketched the trees, during his travels both in Africa and Australia. Adansonia is a genus named by Linnæus in honour of Michael Adanson, a French botanist, who travelled in Senegal between the years 1748 and 1754. It belongs to Bombaceæ, a sub-order of Malvaceæ, and includes only two species, one an African and the other an Australian plant. It is to the African species (*A. digitata*, L.) that we wish to draw the attention of our readers in this paper.

The African Baobab is remarkable not for its great height, but for its immense girth, and the great extent of its spreading branches. Adanson measured several trees, the circumferences of which ranged from 65 to 78 feet, while the huge branches, measuring some 40 or 50 feet long, and whose ends touched the ground, sprang from the

main trunk at no greater height than 12 or 15 feet. He computed that a plant one year old would measure 1½ inches diameter, and be 5 inches high; at 30 years old, it would be 2 feet diameter, and 1 foot 10 inches high; at 100 years, 4 feet diameter, and 2 feet 5 inches high; at 1000 years, 14 feet diameter, and 4 feet 10 inches high; at 2,400 years, 18 feet diameter, and 5 feet 4 inches high; and at 5,150 years, 30 feet diameter, and 6 feet high. If these calculations were true, the trees would be considerably thicker than they are high. Who can venture to verify these statements, or to tell the ages of such trees as Adanson saw in his day, and modern travellers have frequently seen since? Two of the trees seen by the old French traveller had European names cut into their trunks, one bearing date of the fourteenth and the other of the fifteenth century. These names were sunk to a great depth in the wood, owing to the growth of the successive ligneous layers forming around them. That the trees attain an immense age is very evident. Humboldt speaks of them as the "trees of a thousand years," and considers the Baobab the "oldest organic monument of our planet." It is found growing all over tropical Africa and the East Indies. Its head quarters, however, is in Africa, and the trees seem to have been pretty abundant in the track of the Livingstone expedition. Dr. Livingstone tells us, in his African travels, that these trees, which are called Mowana trees in the Bechuana language, are the most wonderful examples of vitality in the country, and when the expedition came upon a dead one, some little surprise was created, after having read what Adanson and others believed, that the trees which they saw were alive before the flood. Mr. Baines, who was artist to the first expedition, tells me he believes they begin to appear a short distance above the low lands of the delta of the Zambesi.

Near the village of Shupanga a venerable tree stands, some sixty feet in girth, its branches twisted and gnarled, and resembling some monster oak of our own forests, excepting that it is thickly overhung with luxuriant tropical creepers. It is under this tree, we believe, that Mrs. Livingstone lies buried. Many fine Baobabs occur in the neighbourhood of Tette, and one, most singularly formed, stands almost in the very town. Tette is the chief town of the Portuguese on the Zambesi. It is about three-quarters of a mile square, and is situated on the south bank of the river, which protects one side of it; the other three sides are surrounded by a wall, with bastions defensible against musketry. Two streets run through the town, parallel with the river, the houses being built on elevated ridges, for the purpose of keeping them as high as possible above

the heavy vapours, in which the fever—often so fatal to African travellers—lurks, while the hollows between form the streets. The fort is a rough building, mounting six or eight guns of various calibre; none, however, larger than 9-pounders. There is a building used as a hospital, and there is also a church, which latter, as far as external appearances go, much more resembles a large thatched barn, but internally it is decorated with some degree of taste, and possesses a set of tolerably good images, life size, used for carrying in their processions during the religious ceremonies. Including the suburbs, Tette has a population of about 6000 people, the majority of which are natives. In the south-west side of the wall, which, we have before said, encloses three sides of the town, a breach of considerable size occurs, and outside this breach a large Baobab stands, or rather lies, for it appears to have grown in shallow soil over a rock eight or ten feet square, and when the surface was washed away by rains, the tree had no doubt fallen owing to the roots, which it had sent out on every side to embrace the rock, proving insufficient to support it. The base of the tree, however, is sufficiently large to cover the rock, and it retains a very perfect impression of its form; but the stem rapidly diminishes upwards to about seven feet in diameter. It is impossible to say how many years have elapsed since this tree fell from its normal position. It is not, however, uncommon to see the trees more or less in this condition. It is very probable that the fall may be gradual, owing to the great weight of the branches, together with the foliage and heavy fruits accumulating in the course of years, the softness of the wood also allows of the entire trunks bending to such a degree, and not breaking. Nor are the ordinary functions of vegetation at all impeded in trees which have assumed these grotesque forms. The circulation of the sap is carried on, so that the branches put forth their leaves and blossoms equally with the younger and more normally conditioned plants, though as regards young plants, travellers have remarked that very few are to be seen even in the parts where the old trees abound. Mr. Baines says of this particular tree at Tette, "I made a sketch of it, and Dr. Kirk obtained leave to cut a section, but we had no saw large enough to work across the trunk, nor if we had, could we have worked it in the soft wood, so saturated with sap, and the cutting out of a section with axes would have been a work of so much time and labour, that we could not spare hands for it."

Sometimes the trees assume a low stunted form, with short, swollen excrescences, apparently in place of branches, only a few

twigs shooting forth here and there. At other times, they may be seen exceedingly broad, and resembling masses of masonry more than the trunks of trees.

The magnificent tree shown in the plate stands in the village of Nyaruka, below Shupanga. The circumference of the trunk is about fifty feet, and some of the branches show a peculiar flattening of the sides, and proportionate increase of depth, which nature seems to regulate so as to enable them to bear the greatest possible weight. In the distance is seen a tree known as the "massaa," into which natives are throwing sticks to bring down the fruits, which are dried and preserved for food. One of the canoes of the country is also introduced. They measure about fifty feet long, and four or five feet wide and deep, and are cut from a solid log. Through Damara or Namaqua land, from Walvisch Bay across to the west coast of the Zambesi, the Baobabs seem to be scant, and in many places to disappear altogether. This is particularly the case in latitude about 22°; but as Lake Ngami is neared from this direction, in lat 20° 18′, several fine trees again appear, in the immediate vicinity of the lake. They appear to be not so large, but of more compact and uniform growth. Occasionally, however, a grotesque and misshapen tree may be seen amongst them. Some very fine trees are to be seen at the east end of the lake, as well as at intervals along the Bo-tlet-le river, and by the scanty pools which occur on the elevated riverless plain. These trees average sixty to sixty-five feet in height, some of them spreading their great roots to a distance of thirty feet or more upon the surface of the limestone plain, and looking not unlike ridges of rock themselves. Some very fine trees also occur near the Lua, a tributary of the Zambesi. One of these is shown in an oil-painting by Mr. Baines, in the Kew Museum.

The Baobab is a most useful tree to the natives, for it furnishes them with clothing, food, and medicine. The bark is fibrous, and very strong. In Senegal, it is woven into cloth, and is a constant material for the manufacture of ropes in all parts where the tree grows, not only in Africa, but in India; for it is said to give rise to a common saying in Bengal, "As secure as an elephant bound with a Baobab rope." The method adopted by the natives in Central Africa for obtaining the fibre is somewhat curious. They do not strip the trees at once, or lop off branches for the purpose, as is usually done with other fibrous barks; but when a native wants cord, he makes a cut in the bark about the height of his knee; he then takes the end of the bark, and strips it to about breast-high,

where he cuts it off. When the tree has so grown that this denuded ring is five or six feet above the ground, some one of the next generation repeats the process, and the tree grows up, leaving the scars of these successive injuries. Some trees bear the marks of nine or ten successive strippings, extending half way up the trunk, and forming a series of complete circles or rings around it, frequently projecting so far from the actual level of the trunk as to enable a person to walk round it by holding on to the one above.

The colour of this fibrous bark is mostly of a neutral grey, but a thin outer bark is seen on some trees, of a red or copper colour, which at first is quite smooth, but afterwards splits and curls off, showing the green bark underneath. This splitting of the outer bark gives to the trunk a rough, uncouth appearance. Very strong ropes and nets for catching antelopes are made from the bark.

The fruit of the Baobab is an oblong or oval woody capsule, and hangs from the branches at the end of a long stalk. It frequently measures from twelve to eighteen inches long, and six inches or more across. It is covered with a greenish soft down, and internally it is divided into eight or ten cells. The seeds are numerous, and are imbedded in a pulpy substance, which has a pleasant acid flavour, and when dry is easily pulverized. In Cairo, this is constantly done, and the powder is used for medicinal purposes. In its fresh state the pulp is eaten by the natives, and elephants are said to be exceedingly fond of it. In Central Africa, a regular dish is made from it, by beating it up with water to the consistency of a thin paste, which is eaten by dipping in the forefinger, and then sucking it. In some parts, the juice is expressed from the pulp, and is much valued as a medicine in cases of fever. The woody capsules, after the pulp and seeds have been carefully removed, make excellent vessels for holding water, etc. They are also reduced to ashes, which, along with the ashes of the bark, is boiled in palm oil for use as soap. The leaves, which are palmate, giving rise to the specific name, *digitata*, are occasionally used by the natives for covering their huts; while on the eastern coast of Africa they are carefully dried, and reduced to a powder, which they daily mix with their food, and which has the effect of diminishing the excess of perspiration occasioned by the heat of the climate.

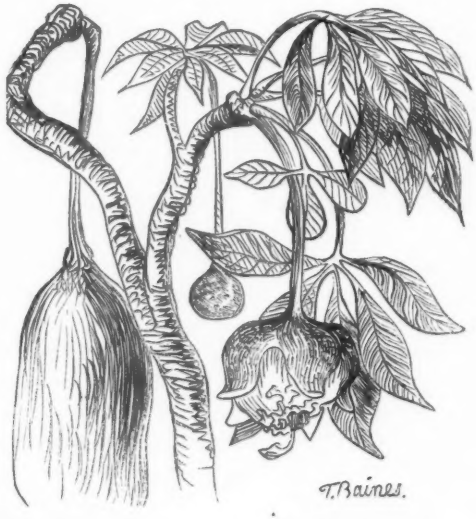
The wood, as we have before said, is exceedingly soft and porous, and it is very liable to the attacks of fungi, and this is said to be particularly the case in Eastern Africa. When so attacked, the wood, of course, soon decays, so that the trunks are very easily hollowed out, and within them the dead bodies of such as are

refused the rite of burial are suspended. They soon become dry, and require no process of embalming. During the progress of the Livingstone expedition, an amusing incident occurred, illustrating the rapidity with which the wood absorbs moisture. In crossing the Lua, a tributary of the Zambesi, one of the party made a large float of thoroughly dry Baobab-wood for the purpose of floating himself across. Before being used it was lighter than cork, but it absorbed the water so quickly, that the unlucky inventor was glad to make all possible haste to shore. It is said that in Abyssinia the wild bees perforate the trunks, lodging the honey in the holes; and this honey is considered the best in the country.

Considering the softness of the wood, it seems surprising how the immense weight of the spreading foliage and heavy woody fruits is supported. Nature, however, appears to have provided bulk of stem to make up for loss of strength; and it is also a remarkable fact, that when the foliage on a particular branch increases so much as to become too heavy for it, the branch itself also increases in thickness. Not, however, equally throughout its circumference, but in a vertical direction, so that the new wood is formed precisely in the position where the greatest strength is required.

The flowers of the Baobab are borne on footstalks four to six inches long. The calyx is very large, and cup-shaped, green on the outside, and covered with short soft hairs. Inside it is of a pale colour, and has a silky appearance. The petals are of a cream white colour, and when the flower is fully expanded, are turned back over the calyx. The stamens are united into a long, thick tube, terminating in numerous filaments, each bearing a one-celled anther of a golden yellow colour. The pistil projects through the stamen tube, hanging down a considerable distance, and terminated by a stigma divided into seven spreading pubescent rays. The tree is deciduous, putting forth its dark green leaves towards the end of our autumn. The flower-buds, however, which in the distance look like small green balls, an inch or more in diameter, begin to open before the young foliage becomes conspicuous, and continues in bloom, while the foliage increases so, that the dark green of the leaves and the cream-white of the flowers offer a pleasant contrast. The appearance of these flowers, when fully expanded, is very beautiful. They frequently measure six inches across. It is no uncommon thing to see the fruits of the past season hanging upon the trees when they are again in flower. Frequently they cannot be got at, owing to the danger of climbing

amongst branches of so soft a wood; or it may be that they are so sheltered by the ramifications of the branches, that the natives are unable to strike them off with the sticks which they throw into the trees for that purpose. The woodcut represents a branch with an old fruit of the past season, a flower-bud, and an expanded flower.



The coloured plate is a reduced copy of a painting, made by Mr. Baines during a boat voyage from Tette to the Kongone mouth of the Zambesi delta, in 1859. From what we have said of the African Baobab, together with the assistance of the plate, we hope that its peculiar form and habits will be understood, and an interest created in its relative in Australia, to which we shall devote our next paper.

IRREGULARITIES OF STRUCTURE IN FISHES.

BY JONATHAN COUCH, F.L.S., C.M.Z.S., ETC.

THERE is no class of organized creatures that is not liable to some degree of variation in structure from what may be termed its natural type; which may be as regards an excess in the number of the organs, or of their deficiency of development; to which may be added some alteration of shape in the body itself, either as concealed within or prominently on the outside. Variations equivalent to these are common also among vegetables; and this more especially when they have been under the influence of human agency; but in the latter instances we are often able to trace the circumstance to some scarcely obscure cause; and not seldom it has been effected by the skill of the cultivator. But in animals, and even such as are beyond human control, while changes in the normal structure have been of not unfrequent occurrence, and the facts have excited wonder even among the students of nature,—and have even stirred up the spirit of superstition in the seemingly devout, no clue to the influencing cause has been hitherto obtained. The subject therefore remains in doubt, although some of the higher interests of the community are mingled with it; for the human race is not less liable to afflictive and untoward malformations than are the creatures which inhabit the woods and waves, or have been rendered submissive to man's domestic control.

In the human race there are many abnormal variations of structure that when brought to the birth are hidden from sight; and many also are the instances of arrested or unnatural development —perhaps of internal organs—which have been the cause of abortion in an early stage of pregnancy, by fatally interfering with the further growth and development of the embryo. It may be that this is less frequent in animals that are altogether wild, and thus beyond the influence of changing and artificial causes; but that it may occur even among the inhabitants of the ocean will appear from the many instances I shall relate, but in which the irregularity of structure has not been so great as to render the subject of it incapable of obtaining subsistence, and of escaping from the pursuit of enemies, of which the number is greater and the ferocity more intense than among the inhabitants of the land; but that there are many which from deficiency of structure are not capable of successful effort to escape, and perhaps of successfully seeking after food, will appear

from close observation to be highly probable. I have supposed, from extensive inquiry, that in the great family of chondropterygian or what are termed cartilaginous fishes, there is less liability to abnormal formation than in what are termed the bony or malacopterygious kinds; and yet in the former class the common picked dog has been found with two distinct heads, which were joined, at what might be called the neck, to a single body. This little creature could scarcely have lived beyond its birth in the sea; but circumstances forbade the trial of its capacity for a separate existence, and its appearance into light took place on board the fisherman's boat; by which accident this remarkable example of the vagaries of nature was preserved to be gazed at as an object of curiosity.

A very young trout has also been seen, with an effort at the development of a second head; which, however, was much less complete than in the instance of the picked dog. That a somewhat similar formation may be met with in even a higher class of animals, with also a much more extensive condition of development, I have witnessed in the instance of a viper; of which it was the more remarkable that two individuals were met with in the same district, with the interval of only a year or two; and of which the supposition may be hazarded, that both were the progeny of the same parent.

As it is intended that our observations shall for the most part be confined to the inhabitants of the sea, I only remark of this instance of a viper with two heads, that when found it had obtained about the fourth part of the adult growth; but as a viper rarely takes its food in captivity it could not be discerned whether it was with one or both of its mouths that food was taken. The heads were separate to a small distance down the neck, and the one that was on the right was in a small degree the largest. They often moved separately, and at times in different directions. The tongues were thrust out independently of each other; but when a particular object excited attention both of the heads were directed towards it, and they moved forward together.

By the side of these remarkable instances of a double development of the head and neck—in a fish and serpent—I place an instance of the doubling of the vertebra in an opposite direction; which was met with in the mud lamprey (*Ammocœtes branchialis*), of which the following is a description. It had attained to a little more than half the usual size of this fish; and the division of the body into two portions was at about the position of the vent, where both the portions became bent down from the straight direction.

One of these portions was longer than the other, and appeared to be the more active in propelling the undivided anterior part; but the somewhat smaller section lay more in a straight line with the direction of the vertebral column. This shorter portion was also in a small degree irregular in shape; and the separation of the two was such that they did not naturally lie close together; in addition to which the shortest portion was bent down at the caudal extremity. At a little before the place of the separation of these distinct portions of the body, there was a faintly marked first dorsal fin, and a second dorsal was at the exact place of the separation, where it was turned into a circle; so that the appearance was as if this fin had taken its course upward along one of these divisions of the body and down the other. This singular example of abnormal form was capable of much activity.

There are other derangements of the bony framework of fishes which are not less decided than those already mentioned, although less conspicuous in their appearance; and of these the absence of the intermaxillary bones, which implies a shortening of the front of the head, is of not unfrequent occurrence. In the salmon peal (*Salmo eriox*) it has several times been observed; and it has been supposed that in the embryotic young of the salmon (*S. salar*) it is common, although these misformed individuals do not survive to show it in their full growth; but it seems uncertain, if the supposition is to be deemed well founded, whether the greater frequency of this defect is among such as have been bred artificially, or that it has only been more frequently noticed. It appears, however, beyond doubt, that the young of fish bred in confinement or by artificial means are more liable to variation of structure than such as are under more natural influences. This deficiency of the intermaxillary bones has also been observed in several species which have little affinity with each other, as the conger Bass, and pollacks, but in all of them the lower jaw has remained of the ordinary length and structure; nor does it appear that this abnormal defect in the upper jaw and front of the head has proved an hindrance to the powers of these fishes in taking their food, or in securing their safety from injury; since the examples which have been examined were of the ordinary size and in good condition. There are other irregular formations of the bones of the spinal column; of which some have led to great distortion of shape, —as if the back, chiefly in its hindmost portion, were lifted into a hump, with a corresponding change of shape in the fins and lateral line—but there are others which have been attended with so little of distortion that the supposition has been hazarded of their being

the marks of distinct species. Mr. Yarrell has recorded an instance of this in the case of the common cod-fish, which had the middle dorsal and first fin short, with the body as deep for its length as the bib—the length of the head compared with the whole length of the fish as one to three. But further, a strong suspicion rests upon what Mr. Yarrell believed to be a species of mugil, and which he has described as the short grey mullet, which, in comparison with the common grey mullet (*M. Capito*), has the length of the head as compared with that of the body and tail as one to three; whereas the proportion of the same parts in the last-named fish is as one to four: the body also deeper, with several other relative differences. I add in this place, with some hesitation, a reference to the fish named the short sea bream, of which a figure and description are given in the "History of the Fishes of the British Islands," vol i., p. 241, and of which not only are the relative proportions different from those of its nearest relative, the common sea bream, but the lateral line and the outline of the edge of the scales are differently shaped. In an example of the trout, the vertebræ behind the vent were so short and pressed together, although their number was normal, that the fish was very short in proportion to its depth.

Some remarkable instances of irregular structure have been observed in the family of Rays (Raidæ); which have led some of the most eminent naturalists into the mistake of supposing that in these examples they had discovered the existence of new species, and even new genera. Our first reference is to what has been called the Cuvier's ray of Lacepede and Fleming, and which is distinguished by the presence of a dorsal fin or elevated membrane at about the middle of the back or disk, in addition to the fins usually situated near the end of the tail. An instance of this formation is mentioned by Dr. Fleming as having been obtained in Scotland; and from the figure of it as given by Lacepede from a dried example, I have no hesitation in expressing the belief, that it was taken from a specimen of our not uncommon spotted ray (*R. maculata*). It appears that Lacepede was desirous of showing that this existence of a fin on the middle of the disk, had not been produced by the hand of man; but although we readily agree with him in this particular, it appears beyond question that in other instances the knife of the fisherman has been successful in imposing on the judgment of Dr. Fleming, as appears more especially from the "Edinburgh Philosophical Journal" of the year 1841; where we have an account, with a figure, of an example from which this learned naturalist proceeded to constitute a new genus, with the name of *Propterygia hyposticta*, and with

which he associates the still more remarkable figure of a fish described by Dr. Alto as obtained by him in the Firth of Forth. In the "History of the Fishes of the British Islands," already referred to, is represented an example of the common skate, in which the expanded disk, or anterior portion of the pectoral fin, was on one side to some extent separate from the head; but beyond this, it is known that in mere wantonness, when a skate or ray taken in a trawl is too small to insure a price on shore, the mutilation has been inflicted with a knife, and the subject of it again set at liberty.

The extent of injury which this family of fishes will survive, is suprising; and besides the fact that a shark has been active for many hours in the sea after its head has been taken off, instances are known of its having taken a bait in the depth of the sea after its liver had been cut out for the purpose of extracting oil, and also when the whole of the entrails had been removed.

As there will not be occasion in the course of our inquiries, to make a further reference to this last-named family of fishes, I will place here the mention of a case—not indeed of abnormal structure—but of function, in the common skate, and which was discovered when the body of a female was opened. It is known that in the ordinary course of nature the purse or case in which the ovum is contained, is deposited externally, and after a time the young one escapes to light and freedom. But in the instance referred to the purse had been retained within the parent, and there the young, when separate from it, had continued, and grown considerably, to its own destruction; but there was nothing noticed in the young fish or its accompaniments that might explain this irregularity of action.

Among the apparently unnatural phenomena in natural history which appear to be the most beyond our power to explain, is the existence of certain changes of structure in important organs, that might appear to be beyond the power of any influence short of violence to inflict; but which are also in regular succession common to all the individuals that inhabit the district, of which an essential character is that it should be fresh water, whether of a lake or river, with an elevated situation; and when this variation or deficiency of structure exists, the proper form is to be accounted the exception rather than the rule. Such are the instances of which particulars are related in the history of the common trout, in the fourth volume of the "History of the Fishes of the British Islands," and which are here given in one view for greater conveniency, but of which it should be observed that there are other lakes and rivers that appear to exist under the like circumstances without acknowledg-

ing the like changes of structure. On this point my only supposition is that a casual change having been impressed upon the parents when the progenitors were few, the same has been continued in the race by regular succession, through the same law as a similarity of national features, and some forms of disease, are propagated, even in human families, for many generations. "So long since as the times of Giraldus Cambrensis, in the twelfth century, it had been noticed that in the Lyn y Cwn, or Pool of Dogs, in Wales, there was a trout which, I suppose not invariably, was deficient of the left eye; and the same was said of the perch and eel which were found in the same water. Strange as this may appear, we learn from Mr. Hansard's "Trout and Salmon Fishing in Wales," that as regards the trout, the fact has been confirmed by a fisherman of that neighbourhood, as also by the Hon. Daines Barrington." A trout with a remarkable distortion of the spinal column into an arch at the situation of the adipose fin—in this respect resembling what has been already mentioned of the cod-fish—is also reported from the same lake; and Dr. Fleming says that the same occurs in the river Enion in Cardiganshire. I have also obtained it from Caldero in Cumberland, where such fish are common; and in two examples which were sent to me, the head appeared unusually large, the hump or elevation was above or opposite to the anal fin, which had only nine rays; and the adipose fin stood on the top of the arch, the body being bent down again at the tail, the upper rays of this fin longest, nineteen in all, its action in a depressed direction, and the arrangement of bones at its root not as in other trouts; the line of the vertebræ so arched as to cause the distortion. But a more remarkable deficiency or malformation is frequent in a trout that is found in Malham Tarn in Yorkshire, for the knowledge of which I am indebted to the kindness of W. Morrison, Esq., M.P. The situation of this tarn is on a hill, twelve hundred and fifty feet above the level of the sea; the rock near is limestone, and the water is clear. The fish are termed silver trouts from the brilliancy of their appearance; but there is another species in the same water, which I have no doubt of being the lake trout—*Salmo ferox*—of which the colour bears a strong impression of yellow. This silver trout reaches the ordinary size of its species and is in good condition; but the deficiency consists in the entire absence of the posterior plate of the gill-cover, sometimes on one side, at others on the opposite, and in an example sent to me this deficiency was on both sides, so that in every instance the fibres of the true gills were bare and open to the water. About one in four or five of the trouts caught in this place are found

to be marked with this deformity; notwithstanding which, the specimens examined bore no evidence of having been subject to any inconvenience from this defect. Besides the casual malformation of a trout caught in Cornwall, already mentioned, where there was a second and smaller head that appeared projecting from the more natural part, Mr. Yarrell mentions one in which there was both a separate head and tail. Deformed trout, of which some are like those already mentioned, are also referred to by William Thompson in his "Natural History of Ireland;" so that as far as observation has extended, no fish appears so liable to irregularities of structure as the trout; and of these, deformities in the vertebral column are especially frequent and conspicuous. In the distinction of nearly allied species of this and other fishes, much dependence has been placed on the number of the vertebræ; and yet on close examination it has been ascertained that in many instances where the species is beyond doubt, the number of these bones has varied, of which the herring is an example, as is also the trout, where the number has been counted from fifty-seven to sixty; and in such cases the number of the fin rays is much subject to diversity. Dr. Gunther in his "Catalogue of the Fishes in the British Museum" (vol. vi.), says of his *Salmo nigripinnis* that a deformed example has been described and figured as the "hog-backed trout" of Plinlimmon; and a similarly deformed specimen has been examined by Dr. Cobbold. Instances have been recorded of the same fish with an undulation in the vertebral column, and a couple of examples where this arrangement of the bones had taken the shape of the letter S. A shortening or distortion of the bony structure of the body must indeed necessarily produce some irregularity in the formation of the fins; but instances are not unfrequent where the fins alone have shown deficiency or exuberance, and in the larger number of instances it is the former. For it is only in the gold-fish—a species that has been long under unnatural influences—that I have met with a positive multiplication of these organs; and it has been only then in reference to the lobes of the caudal fin, the lower portion of which has been separated into two. In one instance a pilchard was destitute of a dorsal fin, without any mark of violence; and in another instance the tail was spread into at least twice the usual dimensions. A conger has been found destitute of a dorsal fin along the back until close to the extreme end of the tail; and I am informed of another in which the anterior end of this fin was turned or twined circularly on itself, somewhat after the manner in which a ribbon is folded up. The blunted end of the tail of this fish, which is of frequent occurrence, may have been

caused by the bite of an enemy, although there has appeared little mark of such violence; but although in such instances a portion of the spine has been deficient, the dorsal and anal fins have become united so as to have little appearance of a defective nature in the caudal structure. In reference to the dorsal fin again, in the hake's dame, or greater fork-beard (*Phycis furcatus*), its elevated and pointed shape is judged to constitute the sufficient distinction from a species known in the Mediterranean (*Phycis Mediterraneus*); but from accident, as seems probable, or want of development, the elevated rays are often deficient, so that only one of them, which may be the first, second, or third, shall project beyond a rather low border, thus tending to throw a doubt on the pricipal mark of distinction between it and a species not yet known as British.

Among the Pleuronectidæ or flat-fishes, it is not uncommon for the flounder, among others, to be equally coloured on both sides, in which case also there is often a defect of outline along the dorsal ridge, by which the head seems less united to the body. A change of aspect is also not uncommon in some species of this family, in which the head is directed, perhaps to the left, when the ordinary direction is the reverse. The topknot (*Rhombus punctatus*), has also been known to have its upper or rough side destitute to a considerable extent of scales and colour, as if a thin skin had taken the place of the usual integument; and more remarkably still, in one instance, the tail was in a rudimentary state so as to have been of little service for motion.

The absence of a fin, or a defect in its structure is scarcely uncommon in other instances; as in the tub-fish (*Trigla hirundo*), where one of the pectorals has been much longer than the other; and in the shanny (*Blennius pholis*), there has been a congenital absence of the pectoral on one side; a deficiency imperfectly compensated by an additional ray to the two in the ventral fin below it. A cod-fish has also been met with, that never had possessed more than one pectoral fin; but a more important defect in an example of this species was the absence of both eyes; and that they had never existed was apparent from the structure of the parts. Yet so effectually had the other organs of sensation supplied the deficiency, that this fish was of full growth and in a well fed condition.

A variation in the internal structure of fishes has been less frequently noticed, but when observed has not been less remarkable. In a cod-fish these organs had suffered such an arrested development, as to deprive it of the faculty of procreation. A salmon has been met with, in which was only a single lobe of roe,

which is normally the case with the atherine (*Atherinea presbyter*); and such was the case also with the milt in all the examples of the samlet (*Salmo salmulus*) that were obtained in the month of December. A case of hermophroditism has been examined in the mackerel, where a small and imperfectly developed milt lay between two lobes of roe. But a still more remarkable structure was examined in the gar-fish, where at first view there appeared to be two pair of fully enlarged lobes of roe; and on closer examination there was found on the right side of the fish a loosely lying lobe, which was directed forward, with its hindmost portion fastened to the side of the body at some distance anterior to the ventral fin, and having no connection with the other lobes, except in lying side by side close to the lobe opposite to it. The lobe here referred to might be said to begin or end, at the vent, and a little posterior to the ventral fins it became contracted, as if tied with a light string; at which place it became united to another lobe, which stretched forward almost to the end of the first mentioned lobe, where the end of the latter appeared as if bent round it. Again, at the vent, in contact with the other that appeared to begin at that place, was a lobe that passed forward without reaching so far as the one already mentioned as being contracted, or tied as with a string. The appearance thus presented was as if there were four distinct lobes each one of which was full of roe; but the first I have mentioned, and which extended further forward than the others, appeared to have been united to the entrail, where the latter was fastened to the side of the body; but as this entrail, had been removed this fact could not be clearly ascertained. The other long, but seemingly double lobe had its orifice at the vent, as had also the short lobe near it; but it is possible that the anterior portion might be able to deliver its grains into the hindmost portion or lobe; and the grains of all had the appearance of being fertile.

On the foregoing subject I add, that in an examination of that prolific species of shark, the picked dog, there has been found two distinct yolks in one ovum, as is sometimes found also in the egg of the domestic fowl; and again, two embryotic young ones have been attached to a single ovum by one cord of connection; which became divided into two branches not far from the point of insertion into their bodies. It is probable from their being thus joined together, that soon after their birth the fate of these united brothers would have been decided, without the prospect of escape.

POPULAR DELUSIONS ON TECHNICAL EDUCATION.

It will only be by a great effort that the average families of the middle class in this country will be induced to become cultivators of science. Amongst the aristocracy, science has a very few distinguished students, but no branch of it can be said to be fashionable, and whenever subjects that require a knowledge of physics, chemistry, or physiology, come before either House of Parliament, a very deplorable amount of ignorance is sure to be displayed. It is, moreover, very rare to find a Cabinet Minister possessed of even elementary education in such a direction, and members of the military and naval professions, who have abundant opportunities for making valuable observations, do not find any official encouragement for such an application of their leisure time. The late Prince Consort endeavoured to raise the tone of education amongst the upper classes, but since his death they have shown little inclination to follow his example. If we look to rich, mercantile, and trading families, we find as a rule that physical sciences are not in much favour. If one of the sons is destined for the medical profession, he first receives an ordinary classical education, and then, with the help of professional "crammers," makes his way as fast as possible through the routine of subjects on which he has to suffer examination. Hence, although it would be easy to make out an honourable list of surgeons and physicians who rank amongst original observers and discoverers, the average "doctor" can scarcely be pronounced a scientific personage, and it is not uncommon to find men in considerable practice who make the most absurd mistakes if they try to talk upon a scientific subject. Another son may be intended for the church, and he is not troubled with science, because neither his parents, his tutors, nor the public have yet arrived at the idea that some accurate knowledge of the works of the Creator is necessary in a profession supposed more than others to be dedicated to his service. A third son may be brought up as a merchant, and a fourth sent to the bar, but like their brothers they will learn no science unless strong personal predilections incline them to its pursuit.

We have recently heard of Oxford and Cambridge M.A.'s perfectly bewildered with a simple astronomical telescope, and nothing is more common than for dealers in philosophical instruments to have them returned with most astounding complaints, arising entirely out of profound ignorance of elementary laws. In one case

that came under our notice, a well-to-do gentleman thought himself aggrieved because a barometer, when carried to a particular place outside his house, did not stand at the exact height at which another barometer, used on another occasion, did stand, as mentioned in a book.

There are throughout the country Field Naturalists' Clubs, and similar institutions which do much to further natural history pursuits, and we have a considerable body of astronomical observers scattered in various directions. Still few take the pains to do anything that is difficult, or to acquire information that demands study or thought; out of a hundred persons who like to join a pleasant excursion, and bring home plants, or bottlesfull of aquatic curiosities, can it be said that five take the pains to learn anything of vegetable physiology, to understand the principles on which botanical classification is based, or to do more than look at the appearance, and pick up from some one else the name of an insect or an infusorian?

It is not with a view of depreciating the attainments of our countrymen that we write these remarks, but for the sake of showing the sort of stem on which efforts are being made to graft technical education, and in the hope of giving timely warning of errors into which the public seem likely to fall.

The prevailing want of scientific knowledge leads to false conceptions of what should be done, now that "technical education" is demanded as an indispensable aid to national prosperity and wealth. There is a notion abroad that professors of science are to teach those portions of their several subjects which can be warranted to pay. "Practical men," that is, persons who act by what is vulgarly known as "rule of thumb," do not want their sons to be taught "theories"—they demand on their behalf what they call "facts." To the chemist they say, what do we care about your theories of composition, your atoms, molecules, laws of substitution, compound radicles, organic bases, and so forth. We want our boys to grow up with the ability to print cotton, smelt iron, or tan skins. They fancy the botanist can tell their offspring how to find new gum trees, or discover fresh dye-stuffs, and so forth, without elaborate inquiries into the organs of fructification, and the relative disposition of parts. Students of medicine coming from unscientific families are often much annoyed and puzzled if a well-informed lecturer brings before them any of the doubts and uncertainties that remain to be cleared up about the structure of organs or their functions. They want positive information. They wish disease to be made as

plain and palpable as a letter-box, and the cure by the administration of a bolus to be as simple as the insertion of an epistle into its appropriate slit.

Persons brought up in what may be fairly called the unscientific atmosphere of common-place English life, have immense difficulties to contend with when they start on a scientific career. Their habitual modes of thought have created an inaptitude for scientific methods, and amongst their relatives or friends, perhaps not one has a particle of sympathy for any of those intellectual pursuits. In London, and very large towns, there are scientific groups to which access is easily obtained, but in smaller towns and rural districts an astronomer, a botanist, or a microscopist often finds himself alone. Scores of letters have reached us with complaints of this description, and we could point to many individuals who under a more rational state of society, would be local centres of scientific intelligence, but who now work like hermits, because the world around them is an intellectual desert, from which they can rarely escape.

A sudden demand for "technical education," without a previous or accompanying one for a general education leading up to it, is much like an application to have a house roofed and its chimney-pots fitted before the foundation is laid, or the walls are reared. The application of scientific principles to any special calling must necessarily and logically come after those principles have been fairly learnt, and it would be impossible to devise courses of study for chemistry, or geology, or physics, that were particularly adapted to cotton-spinners, or iron-founders, and not as useful for other sorts of men. After the general principles and the leading facts of a science have been mastered, its special applications may fairly begin; but special schools should be subsidiary to general schools, and cannot possibly be substituted for them.

If society determined that in a given number of years it would rear up, say a thousand good scientific dyers or smelters, the most certain way to success would be to give a very much larger number of persons a good elementary education in science, and select the most fitting for the more special culture. It would be a waste of time for those who have no taste or inclination towards the sciences to be forced into their prolonged study. To know a little of such matters should be considered, like writing or elementary arithmetic, an essential part of the education of all, and the requisite means should be provided for all. More advanced teaching should be abundantly and cheaply provided for those who desire it; but

no attempt should be made to drive unwilling students through such a course.

In early life tastes are frequently formed which determine the whole current of future endeavour; but some fact or incident is necessary to make the child aware of its natural tendencies. Simple explanations of common phenomena, or the example furnished by seeing others take an interest in particular subjects, may occasion the germination of powers that would have laid dormant without them. If we consider the small proportion of families in the well-to-do classes in which children are likely to have such advantages in reference to the sciences, we may readily believe that only a very small proportion of the scientific capacities of the country can possibly be brought out until a considerable change in the influences which surround childhood and youth have taken place.

Science for all would soon lead to remarkable proficiency on the part of a naturally selected few, while the attempt to deal with great branches of mental culture as if they were simply part of the plant or utensils of a manufacturing business will lead to no satisfactory result. Technical processes can rarely be thoroughly understood by professional teachers. The practical dyer, or spinner, or smelter, finds his commercial success dependent upon details which no lecturer could teach; and if it were possible for school or college instruction to be really successful in making pupils understand how processes were conducted at a particular moment, the very next day fresh processes might be introduced that would render the information of little avail. Of course, if the public demand "technical education" as a substitute for a real education, they will find plenty of quacks ready to supply it for a consideration. There are folks quite ready to keep an emporium of technical education, just as others open a general shop. Chemistry for dyers, botany for perfumers, electricity for telegraph-men, and mechanics for engineers, will be put up and sold like candles and blacking, red herrings and cheese. The Government will, of course, be appealed to by scientific bagsmen touting their wares, and the shade of the Prince Consort invoked to cover any impudent job that may be supposed to need a screen.

Parallel with sham science will run the course of sham art—drawing for the crockery trade, colouring for floor-cloth manufacturers, or perspective for paper-hangers, will be put forth in glaring prospectuses, and proficient pupils will be promised a certificate or a prize. No honourable man who knows anything about science would mix himself with such quackery. A real chemist knows that

there is only one science, which he is named after; and that he cannot subdivide it according to the trade of his pupils' parents, or the kind of calling by which they are expected to grow rich. He has not one chemistry for doctors, and another for glass-blowers; nor does he know any way of teaching except by exhibiting and arranging facts so as to make them illustrate principles and expound laws. The abstruser departments of his science, so far from being the least fitted for those who are about to enter manufacturing industry, are the most essential to any one who is desirous of discovering new products, or improved methods of working those which are already known. Those who have followed the admirable papers of Mr. Barff in our pages will be able to appreciate this fact, and it could not for a moment be doubted by any real proficient in the science. The doctrine of substitution, for example, belongs to a difficult portion of chemical theory. It explains how, in a series of complex substances, certain elements, or certain compounds capable of behaving like elements, may take each other's places. The entire set of compounds so obtained belong to one class or series, and they have certain properties in common; but the substitution of one element for another may make exactly enough difference to serve some important purposes in practical life. A department of chemistry which enters importantly into industrial pursuits is that of synthesis—the artificial formation of compounds exactly resembling, or analogous to, the productions of Nature in the animal kingdom, or in the organic world. Suppose, for example, a chemist were asked to make quinine in his laboratory, instead of obtaining it in a roundabout process, by inducing somebody to grow trees in India from plants collected in America—getting their bark sent to England, and then operating upon it in various ways. The problem would be a hopeless one in the hands of a student who had merely learnt the stuff called "technical chemistry;" but very likely to succeed through the labours of another who had clear ideas of the theory of the science, and who knew how similar productions are formed by Nature herself.

The most successful advances in manufacturing chemistry will be made by those who, having the best understanding of the theoretical composition of bodies, are best able to perceive in how many ways they may be taken to pieces, and what groups of new combinations the several portions may be able to form.

Chemistry affords some of the clearest arguments to show the folly of a "technical" in contradistinction to a real theoretical and scientific education. Theories of science are not mere hypothesis or

supposition. They may not always be right, and they should always be held subject to correction or further elucidation. Their value lies in their quality of co-ordinating facts that belong to the same category, in their enabling reason to be exercised in the consideration of phenomena, and in their indicating the means by which it is possible a control over nature may be obtained. A statement of a law is a shorthand epitome of a group of facts. It matters not how large the group may be, the formula in which the law is stated comprehends them all. Without theories all sciences would be resolved into their primitive elements; they would consist merely of huge heaps of facts which no memory could recollect. A science treated without theory is worse than even the Chinese language with its thousands of characters; the theory comes like a phonetic alphabet, and enables a few symbols to express the whole.

The sciences and the fine arts, as instruments of training and development, deserve a recognition very different from that which the cant and quackery of "technical education" contemplates. Learn science from a love of truth, and for the pleasure as well as for the duty of exercising our faculties upon the phenomena around us. Study art because the perception of the beautiful elevates and adorns our lives. In thus obeying natural laws of mental development, mercantile profit will come in its due place.

WOMANKIND:

IN ALL AGES OF WESTERN EUROPE.

BY THOMAS WRIGHT, F.S.A.

(With a Coloured Plate.)

CHAPTER IV.

THE ANGLO-SAXON WOMEN.

We have no authentic history of what took place in our island during the period between the time when the Roman government was withdrawn from it, and that in which the Anglo-Saxon power became established in Britain; that is, during the first half of the fifth century. The towns seem to have lived in separate independence. Their populations, as I have remarked before, appear to have been recruited in later times chiefly from Teutonic blood; but they had adopted Roman manners, had embraced the Roman civilization, no doubt with most of its vices as well as its virtues, and spoke the Latin language. They were, in fact, looked upon by the invaders as Romans and as enemies, and, as the Teutons were themselves unacquainted with the advantages of living in towns, when these fell under their power they were plundered and destroyed. But the townsmen were protected by strong walls, and knew how to defend them; and the Anglo-Saxon chieftains, as they assumed regal power, soon saw the advantage of compounding with and conciliating the towns, and securing to themselves a revenue by taking a tax just as the townsmen had before paid their tax to the imperial government. Thus there came into existence throughout the country two forms of society, the patriarchal clanship, if we may so call it, of the Teutonic peoples, in alliance with the Roman civilization of the towns. In their slow, imperfect amalgamation, the former gave the force, the latter the polish, to the whole. The Saxon freemen who had conquered the land shared it among them in lots, and each thus became a landholder and the head of a family. In this manner the inhabitants of the towns formed so many little governments republican in character, while the broad lands outside were in the possession of a strong aristocracy, which acknowledged a superior chieftain who claimed the title of king. Thus arose that distinction, we might almost say antagonism, in character and spirit between town and country which has continued, more or less, down to the present time.

When the Anglo-Saxons settled in our island, the patriarchal spirit existed among them in its full force. The father was absolute master in his own family, and could dispose of his children at his will. He sold his daughters into wedlock, and he not unfrequently sold his sons into slavery. An Anglo-Saxon poem of Gnomic Verses, preserved among the contents of the well-known Exeter Book, tells us somewhat quaintly that "a maid is the delight of the eyes" (mægð egsan wyn), and that "a lover requires a physician" (lefmon læces behofað); but the idea intended to be conveyed in the latter saying is not very clear. It is certain that the maiden was entirely in her father's power, and absolutely at his disposal, and that she had no will or choice of her own. In fact, at the time when St. Augustine brought Christianity among our Anglo-Saxon forefathers, maid or wife was regarded absolutely as an article of property, in the one case of her father, in the other of her husband; and the laws of Ethelbert, our first Christian Anglo-Saxon king, contain distinct provisions to meet the crime of stealing them. The words of the first are, "If a man carry off a maid by force, let him pay fifty shillings to her owner, and afterwards buy her from him;" the terms of the other law are, "If a man carry off a freeman's wife, let him procure him another with his own money, and deliver her to him." It appears that the former was the primitive method of procuring a wife; the lover, who certainly ran the risk in this state of things of being in want of a physician, after he had fixed his eye upon a maiden to his taste belonging to some other family than his own, and, perhaps with her secret consent, went with some of his friends and carried her off. This was the form of proceeding of a man who prided himself on his bravery. The girl's relatives took up the feud and pursued him, and the quarrel was only appeased by the lover paying the value fixed upon her by her father, and so retaining possession. My friend Mr. Thrupp, in his excellent and interesting volume, "The Anglo-Saxon Home," has traced the progress of the transition from this rather lawless practice of stealing first and paying the price afterwards, to the more legal and reasonable proceeding of buying in the first place for a stipulated price.

The price of a maiden was generally fixed at so many head of cattle. A passage in the Gnomic Verses of the Exeter Book, which I have already referred to, shows us how universally this practice of buying the wife prevailed. It is as follows:—

Cyning sceal mid ceape	A king shall with cattle
cwene gebicgan;	buy a queen;

bunum and beagum	with cups and bracelets
bu sceolon ærest	both shall at first
geofum gód wesan.	in gifts be bounteous.

Thorpe's edit. of the "Codex Exoniensis," p. 338.

At a later period, when the peoples began to enter more extensively into diplomatic relations with other countries, the king gave away his daughters for political purposes; but their own feelings were never consulted. So, after the introduction of Christianity and monasticism, the father dedicated his daughter to a monastic life, if he willed it, long before she was capable of forming a judgment for herself. In the middle of the seventh century, when Oswy, king of the Northumbrians, had defeated and slain Penda, the pagan king of the Mercians, he gave his daughter to Christ, who thus, according to the views of the church, became her spiritual husband, and consecrated her to Him in perpetual virginity. Bede, who was nearly a contemporary, tells us that the princess was at that time scarcely a year old. The clergy laboured to weaken and break down the power of the father or husband, and especially the former, over the daughter or wife, and they were in the end successful. The change was going on gradually for three or four centuries, and it was not till after the middle of the tenth century that woman obtained the right of insisting upon her own objection to any husband proposed to her by her father, and thus became her own mistress. It may be remarked, that the memory of the old principle of the father's right over his daughter is still preserved in the marriage ceremony, in our modern form of a father giving the bride.

The primitive marriage ceremony among our forefathers was very simple, consisting, in fact, of a bargain and a sale; its principal form was hand-fasting (hand-fæstnung), or pledging each other's hand. The contracting parties took each other by the hand, proclaimed themselves man and wife, and made certain promises of love and affection on the part of the bride, and of good treatment and protection on that of the husband. The lady's friends were present, and her father or guardian received the purchase-money, which had been agreed upon, and delivered her to the bridegroom. In a bargain like this, it is evident that a good amount of deception might be practised on the part of the father in misrepresenting his daughter's qualities or attractions, and this was evidently not uncommonly the case, for one of our earliest codes of Anglo-Saxon laws, that of Ethelbert, Augustine's convert, contains a provision against it. It was, no doubt, a very early law of the Anglo-Saxon people, for, though written in the code of laws as prose, it seems

by its rhythm and the natural division of the lines, to have been originally composed in alliterative verse, to be more easily carried in memory by the primitive dispensers of justice, and I will therefore give it here, arranged in verse, as a singular monument of primeval manners:—

Gif man mægð gebigeð	If a man buy a maiden
ceapi, geceapod sy,	with cattle, let the bargain stand,
gif hit unfacne is;	if it be without guile;
gif hit þonne facne is,	but if there be deceit,
ef[t] þær æt ham gebrenge,	let him bring her home again,
and him man his scæt afere.	and let man give him back his money.

"Ancient Laws and Institutes of England," vol. i. p. 22.

We have no direct information as to the limit of time after marriage, in the earlier ages, within which the husband was required to send back his wife to her father if dissatisfied with her. In course of time the father sought to conceal the mercantile character of this transaction, by representing it as a compensation for the expense for the young lady's feeding and education; and the money paid was then called a *foster-lean*, or payment for nourishing.

The custom of espousals also prevailed among the Anglo-Saxons at an early period, that is, the father entered into an engagement for the future marriage of his daughter at any period before she had reached a marriageable age. After the introduction of Christianity, the clergy gradually reduced this engagement to a regular and stable system, by applying to it the Roman law of espousals; and the lover was required to give at that time a *wed*, or security, for the due performance of his part of the contract. Hence the ceremony of marriage has been called in English, down to the present time, a *wedding*.

At first the foster-lean was expected to be paid at the time of the espousals, which was a sort of selling beforehand, and led to other abuses. By the law of espousals, by which the ecclesiastics sought to establish more and more their influence over the female sex by emancipating them from the paternal power, the contracted bride, up to a certain age, had the right of refusing to perform the contract; if she did this at ten years of age, the contract was void, and neither father nor daughter were liable to any punishment; if she did it at any time between her tenth and twelfth years, the father was liable to a fine; after that age, both were punishable. It is evident how this law might be abused by the father of an attractive daughter, who might espouse her and obtain the foster-lean, and then espouse

her to a second lover, and obtain a second payment, and so on to the third, and all this without parting with the girl, yet retaining the money. It will be seen that in these primitive times, lovers were liable to be imposed upon in more ways than one. And we may be sure that this last-mentioned mode of deception was not of very unfrequent occurrence, for, though not provided against in the secular laws (for the practice of such matrimonial pre-contracts was an ecclesiastical institution), yet it was condemned in the laws of the church, and in the Pœnitentiale of Theodore of Canterbury, and the Confessionale and Pœnitentiale of Ecgbert of York, there are severe enactments against it. The latter orders that if any woman be espoused (*beweddod*) to a man, and another take her from him, she shall be excommunicated; and in the two former codes it is ordered that "it is not permitted to her parents to give a girl, who is espoused to another man, unless she declare that she is altogether resolute not to have him."* This ecclesiastical law appears not to have been popular among the people, and instead of allowing the espoused girl, when she refused the first husband provided for her, to be given to another, Theodore and Egbert's ecclesiastical law ordered her to retire to a convent. Still this proved unsatisfactory, and it was finally arranged that the foster-lean should be paid, not at the espousals, but on the completion of the marriage.

The clergy had laboured to introduce more formalities into the ceremonial of marriage, and to add to it more that was typical and figurative. At the espousals, after the taking of hands, the couple who were thus engaged, made an exchange of presents. Among those given by the bridegroom was a ring, which was placed on the maiden's right hand, and which was to be worn so until the time of her marriage. They also exchanged a solemn kiss, which was looked upon as having a spiritual meaning. At the marriage, if espousals had previously taken place (for they were not *necessary*), the ring was removed by the bridegroom to the bride's left hand, and was placed on the first finger—if there had been no espousals, he then gave it her, and placed it on the first finger of the left hand. The father then transferred to the husband his authority over his daughter, which was called in Anglo-Saxon the *mund* (from *mundian*, to protect), but for this also he required payment. This transfer was made by another typical gift; the father delivered the bride's shoe to the bridegroom, and the latter touched her on the head with

* "Puellam desponsatam non licet parentibus suis dare alteri viro, nisi illa omnino declarat se eum nolle; tunc, si velit, licebit ei id derelinquere, et vitam monasticam sibi eligere, si velit."—"Confes. Ecgberti," 20. Compare "Theodori Liber Pœnitent.," vi. 29.

it, whereby he was considered to assume the marital authority. This early ceremony, too, is still preserved in memory in the popular custom of throwing a shoe after the newly-married couple when they are starting on their wedding excursion.* After these mere ceremonies were over, came the more substantial considerations on both sides, which had been arranged beforehand, but which had now to be completed. Among these, the most remarkable was the gift made to the wife by the husband the morning after the marriage, and called from this circumstance the *morgen-gifu*, or morning-gift. It was originally a mere voluntary gift, made on the morning after the wedding, to testify the degree of satisfaction of the husband with his wife, and depended upon his natural generosity and upon his approval of her. Afterwards it was considered as one of the most indispensable articles of the marriage-contract, and the amount was stipulated before the ceremony, partly because it was an acknowledgment that the husband was satisfied, and, after he had given the morning-gift, he had no longer the right of returning his bride. It was at first a comparatively trivial present, but it afterwards became, among wealthy families, a large amount of property, and sometimes consisted of considerable estates, which were the absolute property of the wife, and she had the full power of disposing of it if she became a widow. Thus, at the close of the tenth century, the Lady Wynflæd, by her will, leaves to one of her relatives the estate at Faccancumb, which had been given to her as her morning-gift; and, near the same date, Elfhelm makes an entry in his will, "And I make known what I gave my wife for a morning-gift; that is Baddow, and Burstead, and Stratford, and the three hides at Heanhall; and I gave to her, when we first came together, the two hides at Wilbraham, and at Rayne, and what is thereto adjacent."† The practice of the morning-gift was established throughout the Teutonic race. When King Athelstan's sister, Eadgith, was married to Otho, Emperor of Germany, her imperial bridegroom gave her for her morning-gift the city of Magdeburg.

* It has been supposed that this custom of the gift of the shoe had its origin in that of placing the foot on the neck of prisoner or slave, and that it was typical of the state of subjection in which the bride was placed towards her husband. When the married pair retired to rest, it seems that the shoe was placed at the head of the bed on the husband's side; and that, by way of practical joke, when the lady was accused of being rather tyrannical in temper, some facetious individual sometimes stole into the room, and slyly transferred the shoe to the wife's side. See Mr. Thrupp's "Anglo-Saxon Home," already referred to, for a longer and more detailed account of the customs and ceremonies of the Anglo-Saxon marriages than I can give here.

† See the original wills in Thorpe's "Diplomatarium Anglicum Ævi Saxonici," pp. 533 and 596.

In all these stipulations of inferiority and subjection of the wife to the husband, there was far more of theory than of practice. The natural influence of Womankind soon overruled and suppressed them, at least practically, which was of greatest importance. If she was bound to an apparent subservience, he was bound to cherish and protect her; and he had, as far as his means went, to endow her with property. The position of the wife, and indeed of woman generally, went on improving during the whole Anglo-Saxon period. By the time of Cnut, it had become usual, if not compulsory on a man of any property, to make at his marriage a substantial settlement upon his wife, and she had a legal right, upon his death, to a certain portion of his wealth. But, if the widow married within a year after the death of her husband, she forfeited everything she had received from him. This is, no doubt, the origin of our feeling that a widow ought to remain a year after her husband's death before marrying again. Singularly enough, the Danes, who are usually looked upon as mere sanguinary savages, appear to have been instrumental in finally raising the position of Womankind in England, and the sex appears as enjoying most consideration and protection, legally at least, in the laws of King Cnut. One of woman's domestic privileges among the Northmen was curious enough; she had a right to the custody of her husband's keys, and, if he refused, she had a remedy at law, by which she could compel him to give them up to her. Cnut introduced this provision into the Anglo-Saxon laws, and he did so with the object of abolishing a part of the older Anglo-Saxon law, which was very cruel towards the wife and family. By the earlier laws, if a husband commited theft, his wife and all his family, even the child in the cradle, as well as himself, were liable to be sold into slavery, and this continued to be the case for a long period, until Cnut abolished it. He enacted that in regard to the object stolen, "unless it has been brought under his wife's key-lockers (*cæg-locan*), let her be clear; for it is her duty to keep the keys of them, namely, her "hord-ern," and her chest, and her 'tege.' If it be brought under either of these, then she is guilty."* These three depositories are to be explained as her store-room, her chest, and her cupboard, and they are apparently those parts of the house only which were locked.

The interior of the house, indeed, was the wife's special province, and, as with the Roman lady whose epitaph has been given in a former chapter (STUDENT, No. II., p. 92), one of her most estimable virtues was being "a keeper at home." In the poem

* "Ancient Laws and Institutes of England," vol. i., p. 419.

of Gnomic Verses, quoted before from the Exeter Book, we are told:—

Fæmne æt hyre bordan geriseð;	A damsel it beseems to be at her table;
wid-gongel wif word gespringeð,	a rambling woman scatters words,
oft hy mon wommum bilihð,	she is often charged with faults,
hæleð hy hospe mænað,	a man thinks of her with contempt,
oft hyre hleor abreoteð.	oft smites her cheek.

Thorpe's "Codex Exon.," p. 337.

The females of the Anglo-Saxon household were not idle in their bower, but, as with the Franks also, worked industriously, both in producing the materials of the dresses, and other objects used by their husbands and themselves, and in making them. We have from time to time, in early writers, allusions to this domestic industry. In the Pœnitential of Theodore of Canterbury, which dates from soon after the middle of the seventh century, women are forbidden to employ themselves on Sunday, either in weaving or in cleaning the vestments, or in sewing them, or in carding wool, or in beating flax, or in washing garments, or in shearing the sheep, or in any such occupations.* Here we see, at that early period, the whole process of the construction of clothing entirely in the hands of the women of the household. Boniface, in one of his letters (Epist. 20), tells of a damsel who was grinding in a mill, and who saw lying near her another woman's new spindle, which was ornamented with carving (*novam colum sculptura variatam*), which seemed to her so beautiful that she stole it. The distaff was so generally the distinguishing implement of the lady of the family, that the word distaff, or spindle, was used for her in distinction from the spear, as distinctive of the man. King Alfred, in his will, made soon after the year 880, says, in his directions for the distribution of his property, that his grandfather had bequeathed his lands "to the spear-side (on þa spere-healfe) and not on the spindle-side (on þa spinl-healfe), and that, therefore, he wished it to go by preference to his male descendants.† These occupations were considered equally fitting to queens and princesses as to ladies of ordinary rank. William of Malmesbury

* "Item feminæ opera textilia non faciant, nec abluant vestimenta, nec consuant; nec lanam carpere, nec linum batere, nec vestimenta lavare, nec verveces tondere, nec aliquid hujusmodi habeant licitum." Theodor. "Pœnitent." p. 45, in the "Ancient Laws and Institutes," vol. ii.

† See Alfred's will in Thorpe's "Diplomatarium," p. 491.

tells us that the daughters of King Edward, Alfred's son and successor, employed themselves from their childhood in the labours of the distaff and the needle. Long before this, in the seventh century, Aldhelm, who wrote especially for the ladies, had made the distaff (*fusum*) the playful subject of one of his riddles. Before the Norman period, the English ladies had become celebrated even on the Continent, for their skill in spinning, weaving, and embroidering; and one of the Norman writers on the history of the Norman conquest of England, whose name is not known, tells us how the French and Normans admired the beautiful dresses of the English nobility, and adds that the English women "excell all others in needlework, and in the art of embroidering with gold."* Another Norman writer of the same period, William of Poitiers, assures us that the Anglo-Saxon ladies were so celebrated for their superior skill in embroidery, that the finest productions of the needle were called by way of distinction "English work" (*Anglicum opus*).†

With such skill in working the materials, we are not surprised at hearing the old writers more than hinting at the love of the Anglo-Saxon women for dress and ornament. Thus Aldhelm, in the latter part of the seventh century, comparing the women of the cloister with the women of the world, describes the latter as yearning to adorn their necks with necklaces, and their arms with bracelets, and to be decked with rings on their fingers, set with gems. . . . They sought to arrange delicately their waving locks, curled artificially by the curling-iron, with their cheeks died red with stibium.‡ And in another part of the same book, his treatise of the Praises of Virginity, he complains of their changing the natural colour of the fleeces, for woollen was very extensively used in their garments, in order to dye them red, and purple, and various other colours, looking forward to the time when all this vanity will come to an end, and when the wool will cease learning to counterfeit other colours than its own.

Nec varios discet mentiri lana colores.§

We might suppose from the words of Aldhelm that the material used for the dress in his time was chiefly woollen, but we know that linen was also in general use; and at this time silk (*seolc*), and other valuable materials of foreign manufacture, had been introduced.

* "Anonymi Gesta Gulielmi ducis, ap. Duchen.," p. 211.

† Gulielmi Pictavens., "Hist.," ib. 211.

‡ "Ista tortis cincinnorum crinibus calamistro crispantibus delicate componi et rubro coloris stibio genas ac mandibulas suatim fucare satagit." "Aldhelm, de Laudibus Virginitatis," p. 17, ed. Giles.

§ "Aldhelm, de Laud. Virg.," p. 75.

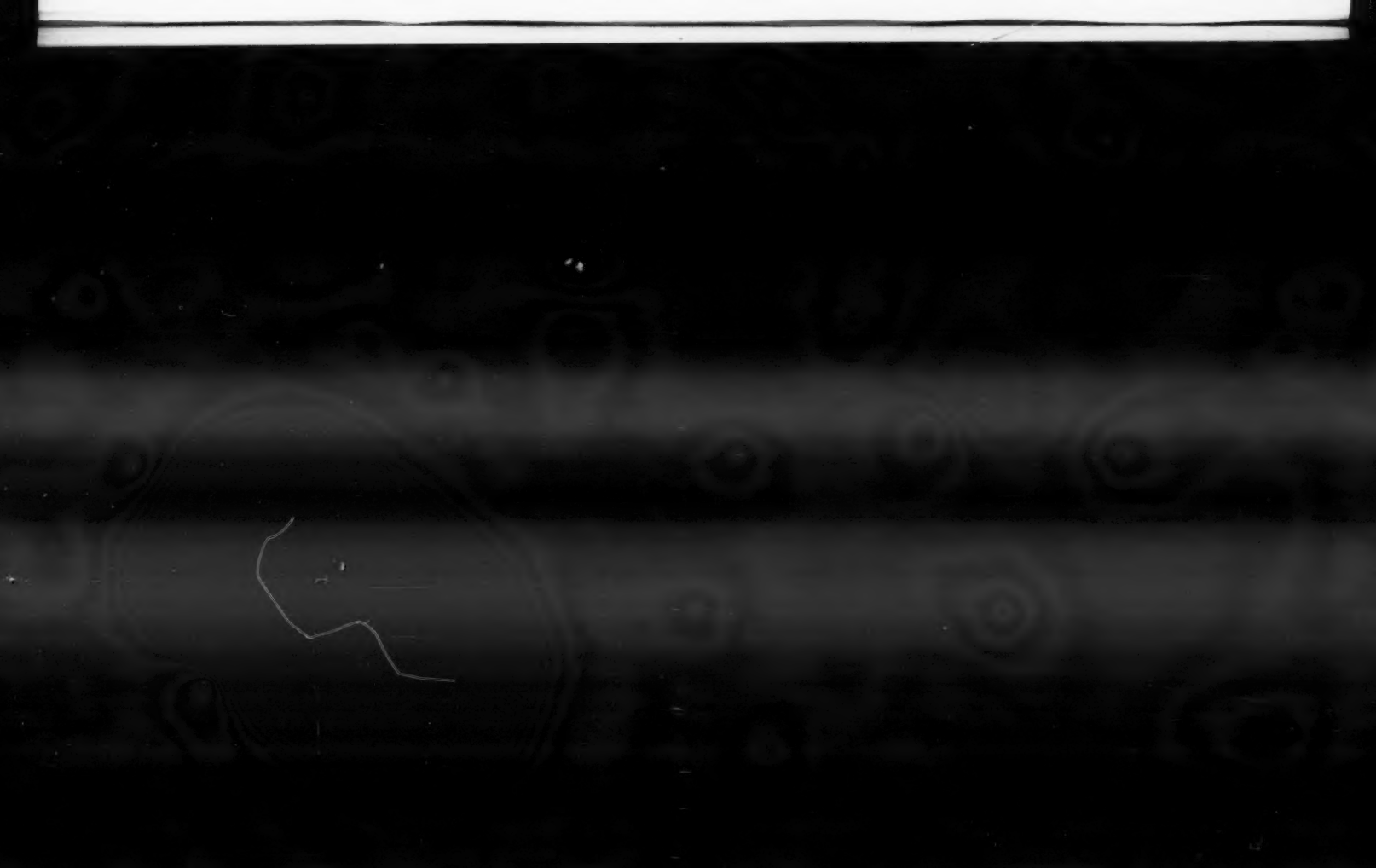
It is to be lamented that the Anglo-Saxon writers who have left us their protest against the richness of the materials, the variety of colours, and the love of jewellery displayed by the Anglo-Saxon ladies, have given us no description of their dress, or of the different articles of which it consisted; and it is only at a comparatively late date that the Anglo-Saxon artists enable us, by the illuminations in their manuscripts, to form a notion of its outward appearance. We have every reason, however, to believe that the Anglo-Saxon costume, which seems to have resembled pretty closely that of the Frank, hardly underwent any change through several centuries, except so far as regarded its richness of material and ornamenta-

THREE OF THE VIRTUES IN ANGLO-SAXON COSTUME.

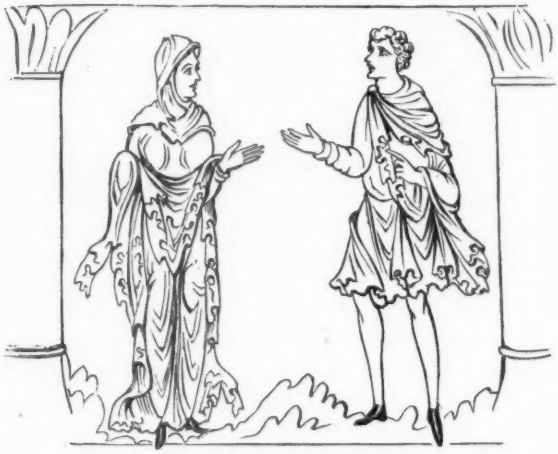
tion. A few groups from the illuminations just mentioned will convey to our readers the best idea of this costume, and of the general appearance of Womankind among our forefathers at this remote period. Our first cut is taken from a manuscript of the Psychomachia of Prudentius, which is, perhaps, of the latter part of the tenth century (MS. Cotton. Cleopatra, C. VIII. fol. 4, v°.). The original represents the lady Wisdom addressing the Virtues, three of whom are here given as good examples, not only of the costume, but of the gesture, and action, and characteristic appearance of Anglo-Saxon ladies at this date.

The garb of these Anglo-Saxon ladies is extremely modest; very different from the older dresses of the Roman and Romano-Gallic period, and from what is understood to have been the costume of

A PATRIARCHAL FAMILY.



the older Germans, nothing is here uncovered but the face and hands. In the second cut, which represents a conversation between two persons of different sexes, and is taken from the same manu-



AN ANGLO-SAXON CONVERSATION.

script (fol. 31, r°), the lady presents exactly the same characteristics of costume and the same style of character; she is intended here to represent Faith, and in the original she is preaching to a crowd of people, of whom only one is introduced here that we may contrast the costume of the two sexes.

It has been stated in the preceding chapter, how the *camisia* (the French *chemise*) was added to the older Roman costume at the close of the western empire. It was no doubt adopted from the Franks by the Anglo-Saxons, for in the Anglo-Saxon glosses it is explained by the same word in an Anglo-Saxon form, *cemes* or *cemis*, and it no doubt held the place of the modern shift; that is, it was the garment next to the skin, and it was probably of linen, but, as may be supposed, it is never visible in the drawings. Over this was thrown the tunic, which also was derived, no doubt, from the Romans, and had preserved its Roman name in that of *tunica*. It was a long full dress, almost concealing the feet, and had close sleeves reaching in rolls to the wrists, where they appear to have been usually confined by a bracelet. As the Anglo-Saxons had, in some cases, more than one word for the same article of dress, we often find a difficulty in identifying them. Such is the case with the word *cyrtel*, our modern *kirtle*. It is used in the old glosses to ex-

plain the Latin *tunica*, so that it seems to have been another name for the garment just described, or perhaps of an outer garment of the same kind, answering to the outer tunic of the Roman ladies. We certainly see on the ladies of the Anglo-Saxon illuminations two robes, one over the other; the outer of which is raised, and shows that they differ in colour and apparently in materials, while the inner dress can hardly be the *camisia*. This part of the dress was tightened round the waist by the girdle, which is often very broad, but sometimes so narrow as to be little more than a belt. Over all these was thrown a mantle, answering to the Roman *palla*, and derived apparently from it. The Anglo-Saxon name for it was, perhaps, a *wæfels;* at least that word is given in the Anglo-Saxon glosses as synonymous with the Latin *palla*. The mantle of the Anglo-Saxon ladies appears to have been formed exactly like the *palla*, and to have been put on and worn in the same manner. The Anglo-Saxon ladies, like the Franks, seem to have always worn a covering to the head; at least they are always represented thus covered in the engravings, and it will be best understood by our cuts. It appears to have been usually called simply a head-rail (*heafod-hrægel*), or head-garment, for we are not aware of any special name given to it among the Anglo-Saxons. It appears sometimes as covering the head closely, and reaching no lower than the neck; at others, and in fact usually among the Anglo-Saxons, it sits looser and flows over the shoulders, and even beyond them, so as to form a kind of hood. Sometimes the lower part appears to be separate from that which covers the head, and the former may then be what the Anglo-Saxons called the *winpel*, or wimple.

We will now pay a visit to the Anglo-Saxon ladies in two other illuminated manuscripts of the period, and, if we learn not much more of their dress, we shall at least see them in other situations and characters. The works of the Anglo-Saxon artists of this period are singularly characterized by their spirited sketchy style of drawing, which is quite peculiar to them, and executed with a skill we could hardly expect, and of which the two manuscripts just mentioned are excellent examples. The first is a fine manuscript in the Harleian library in the British Museum (MS. Harl., No. 603), containing a copy of the Book of

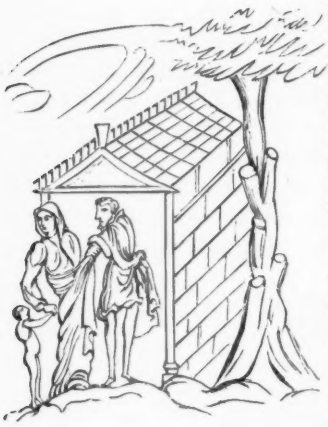
A GROUP OF ANGLO-SAXON WOMEN.

Psalms in Latin, profusely illustrated with these sketches. I give in the preceding cut, as an example of its style, a small group of Anglo-Saxon women, evidently all in a state of excitement; the two foremost seem especially agitated, while the one behind appears to be possessed with a degree of quiet dignity which is not easily ruffled. The second of our manuscripts is an equally fine and valuable volume (MS. Cotton. Claudius, B. IV.), containing a copy of the Anglo-Saxon translation of the Pentateuch by one of our most celebrated Anglo-Saxon prelates, Alfric of Canterbury. It is, like the other manuscript I am now using, largely illustrated, in a different style of art, but still the drawings are often as full of spirit as they are truthful. I give, in the next cut, an

AN ANGLO-SAXON FAMILY.

example from this manuscript (fol. 46, v°). It is intended in the original to represent the patriarch Jacob and his wife Leah, and his two sons by her handmaid Zilpah, Gad and Asher. It was a peculiar characteristic of the draughtsmen of the middle ages, and especially in the illuminated manuscripts, that, whatever might be the subject, they invariably drew it in the costume and manners of their own time. The scene before us may be described in entire correctness as an Anglo-Saxon family group—the head of the family and his wife seated on their settle, or double seat, and accompanied by their two boys. The father is dressed in his in-door costume; their

mother in the full dress of the Anglo-Saxon dame, as just described; the eldest of the boys has reached the age at which he is allowed to have at least a mimic sword. Our last cut on the present occasion is taken from the previously-described manuscript of the Psalms (MS. Harl., No. 603, fol. 15, v°). It represents a man, with a woman and child, at the entrance to what is, perhaps, intended to be a temple. It is the same style of costume, with the exception of the child, which is perfectly naked. Perhaps this is characteristic of a lower class of society.



Our coloured plate is another scriptural subject from the manuscript of Alfric's version of the Pentateuch (MS. Cotton. Claudius, B. IV., fol. 51, v°), and it may be taken as a very good example of the Anglo-Saxon idea of a patriarchal family. It is true that it represents the children of Jacob with their mothers, Leah and Rachel, and their handmaids, Zilpah and Bilhah. To the left we see Rachel and her single son, and Leah with her six—her daughter is not counted; to the right, Bilhah and Zilpah have respectively their two sons (Gen. xxix., xxx.). The costume of Anglo-Saxon ladies and Anglo-Saxon boys is here very well shown; but there is one peculiarity which is deserving of special notice, the colour of the hair—sky-blue. Blue hair is certainly not natural, and can only have been given, as apparently a favourite colour, by artificial means—by powder, or by the process of dyeing. It seems to have been equally a favourite colour with both sexes. Unfortunately, the Anglo-Saxon ladies are invariably represented in the illuminations of the manuscripts with the head covered with the head-rail. There is one exception: when Eve appears in Paradise with no covering of any kind for any other part of her body, it is not to be expected that she would have a covering for her head, and accordingly we find her in her hair. Her hair is blue. We trace in other pictorial manuscripts this taste of the Anglo-Saxons for blue hair. It must, of course, have been coloured artificially, either by a dye or by powder.

(*To be continued.*)

A NEW THEORY OF ACHILLES' SHIELD.

BY R. A. PROCTOR, B.A., F.R.A.S.

A DISTINGUISHED classical authority has remarked that the description of Achilles' shield occupies an anomalous position in Homer's "Iliad." On the one hand, it is easy to show that the poem—for the description may be looked on as a complete poem—is out of place in the "Iliad;" on the other, it is no less easy to show that Homer has carefully led up to the description of the shield, by a series of introductory events.

I propose to examine, briefly, the evidence on each of these points, and then to exhibit a theory respecting the shield which may appear *bizarre* enough on a first view, but which seems to me to be supported by satisfactory evidence.

An argument commonly urged against the genuineness of the "Shield of Achilles" is founded on the length and laboured character of the description. Even Grote, whose theory is that Homer's original poem was not an *Iliad*, but an *Achilleis*, has admitted the force of this argument. He finds clear evidence that from Book II. to Book XX., Homer has been husbanding his resources for the more effective description of the final conflict. He therefore concedes the possibility that the "Shield of Achilles" may be an interpolation—perhaps the work of another hand.

It appears to me, however, that the mere length of the description is no argument against the genuineness of the passage. Events have, indeed, been hastening to a crisis up to the end of Book XVII., and the action is checked in a marked manner by the "Oplopœia" in Book XVIII. Yet it is quite in Homer's manner to introduce, between two series of important events, an interval of comparative inaction, or at least of events wholly different in character from those of either series. We have a marked instance of this in Books IX. and X. Here the appeal to Achilles and the night-adventure of Diomed and Ulysses are interposed between the first victory of the Trojans and the great struggle in which Patroclus is slain, and Agamemnon, Ulysses, Diomed, Machaon, and Eurypylus wounded.* In fact, one cannot doubt that in such an arrangement Homer exhibits admirable taste and judgment. The contrast

* Another well-known instance, where "Patroclus sent in hot haste for news by a man of the most fiery impatience, is button-held by Nestor, and though he has no time to sit down, yet is obliged to endure a speech of 152 lines," is accounted for by Gladstone in a different manner.

between action and inaction, or between the confused tumult of a heady conflict and the subtle advance of the two Greek heroes, is conceived in the true poetic spirit. The dignity and importance of the action, and the interest of the interposed events, are alike enhanced. Indeed, there is scarcely a noted author whose works do not afford instances of corresponding contrasts. How skilfully, for example, has Shakespeare interposed the "bald, disjointed chat" of the sleepy porter, between the conscience-wrought horror of Duncan's murderers, and the "horror, horror, horror" which "tongue nor heart could not conceive nor name," of his faithful followers. Nor will the reader need to be reminded of the frequent and effective use by Dickens of the contrast between the humorous and the pathetic.

The laboured character of the description of the shield is an argument—though not, perhaps, a very striking one—of the independent origin of the poem.

But the arguments on which I am disposed to lay most stress lie nearer the surface.

Scarcely any one, I think, can have read the description of the shield without a feeling of wonder that Homer should describe the shield of a mortal hero as adorned with so many and such important objects. We find the sun and moon, the constellations, the waves of ocean, and a variety of other objects, better suited to adorn the temple of a great deity than the shield of a warrior, however noble and heroic. The objects depicted even on the Ægis of Zeus are much less important. There is certainly no trace in the "Iliad" of a wish on Homer's part to raise the dignity of mortal heroes at the expense of Zeus, yet the Ægis is thus succinctly described:—

> "Fring'd round with ever-fighting snakes, through it was drawn to life
> The miseries and deaths of fight; in it frown'd bloody Strife,
> In it shin'd sacred Fortitude, in it fell Pursuit flew,
> In it the monster Gorgon's head, in which held out to view
> Were all the dire ostents of Jove."
>
> Chapman's Translation.

Five lines here, as in the original, suffice for the description of Jove's Ægis, while one hundred and thirty lines are employed in the description of the celestial and terrestrial objects depicted on the shield of Achilles.

Another circumstance attracts notice in the description of Achilles' armour—the disproportionate importance attached to the shield. Undoubtedly, the shield was that portion of a hero's

armour which admitted of the freest application of artistic skill. Yet this consideration is not sufficient to account for the fact, that while so many lines are given to the shield, the helmet, corselet, and greaves are disposed of in four.

But the argument on which I am inclined to lay most stress, is the occurrence *elsewhere* of a description which is undoubtedly only another version of the "Shield of Achilles." The "Shield of Hercules" occurs in a poem ascribed to Hesiod. But whatever opinion may be formed respecting the authorship of the description, there can be no doubt that it is not Hesiod's work. It exhibits no trace of his dry, didactic, somewhat heavy style. Elton ascribes the "Shield of Hercules" to an imitator of Homer, and in support of this view points out those respects in which the poem resembles, and those in which it is inferior to, the "Shield of Achilles." The two descriptions are, however, absolutely identical in many places; and this would certainly not have happened if one had been an honest imitation of the other. And those parts of the "Shield of Hercules" which have no counterparts in the "Shield of Achilles," are too well conceived and expressed to be ascribed to a very inferior poet—a poet so inferior as to be reduced to the necessity of simply reproducing Homer's words in other parts of the poem. Those parts which admit of comparison—where, for instance, the same objects are described, but in different terms—are certainly inferior in the "Shield of Hercules." The description is spoiled by the addition of unnecessary or inharmonious details. Elton speaks, accordingly, of these portions as if they were expansions of the corresponding parts of the "Shield of Achilles." This seems to me a mistake. I am disposed to ascribe both descriptions to the same poet. It is not necessary for the purposes of my theory that this poet should be Homer, but I think both descriptions show undoubted traces of his handiwork. Indeed, all known imitations of Homer are so easily recognizable as the work of inferior poets, that I should have thought no doubt could exist on this point, but for the attention which the German theory respecting the "Iliad" has received. Assigning both poems to Homer, I look on the "Shield of Hercules," not as an expansion (in parts) of the "Shield of Achilles," but as an earlier work of Homer's, improved and pruned by his maturer judgment, when he desired to fit it into the plan of the "Iliad." Or, rather, each poem may be looked on as an abridgment (the "Shield of Hercules" the earlier) of an independent work on a subject presently to be mentioned.

It is next to be shown that in the events preceding the

"Oplopœia," there is a preparation for the introduction of a separate poem.

In the first place, every reader of Homer is familiar with the fact that the poet constantly makes use, when occasion serves, of expressions, sentences, often even of complete passages, which have been already applied in a corresponding, or occasionally even in a wholly different relation. The same epithets are repeatedly applied to the same deity or hero. A long message is delivered in the very words which have been already used by the sender of the message. In one well-known instance (in Book II.), not only is a message delivered thus, but the person who has received it repeats it to others in precisely the same terms. In the combat between Hector and Ajax (Book VI.), the flight of Ajax' spear and the movement by which Hector avoids the missile, are described in six lines, differing only as to proper names from those which had been already used in describing the encounter between Paris and Menelaus (Book III.).

This peculiarity would be a decided blemish in a written poem. Tennyson, indeed, occasionally copies Homer's manner—for instance, in "Enid," he twice repeats the line,

"As careful robins eye the delver's toil;"

but with a good taste which prevents the repetition from becoming offensive. The fact is, that the peculiarity marks Homer as the *singer*, not the *writer*, of poetry. I would not be understood as accepting the theory, according to which the "Iliad" is a mere string of ballads. I imagine that no one who justly appreciates that noble poem would be willing to countenance such a theory. But that the whole poem was sung by Homer at those prolonged festivals which formed a characteristic peculiarity of Achaian manners, seems shown, not only by what we learn respecting thelater "rhapsodists," but by the internal evidence of the poem itself.*

Homer, reciting a long and elaborate poem of his own composition, occasionally varying the order of events, or adding new episodes, extemporized as the song proceeded, would exhibit the peculiarity invariably observed in the "improvisatore," of using, more than once, expressions, sentences, or passages which happened

* Besides Homer's reference, both in the "Iliad" and "Odyssey," to poetic recitations at festivals, there is the well-known invocation in Book II. To what purpose would the mere writer of poetry pray for an increase of his physical powers? Nothing could be more proper, says Gladstone, if Homer were about to recite; nothing less proper if he were engaged on a written poem.

to be conveniently applicable. The art of extemporizing depends on the capacity for composing fresh matter while the tongue is engaged in the recital of matter already composed. Any one who has watched a clever improvisatore cannot fail to have noticed that, though gesture is aptly wedded to words, the thoughts are elsewhere. In the case, therefore, of an improvisatore, or even of a rhapsodist reciting from memory, the occasional recurrence of a well-worn form of words, serves as a relief to the strained invention or memory.

We have reason, then, for supposing that if Homer had, in his earlier days, composed a poem which was applicable, with slight alterations, to the story of the "Iliad," he would endeavour, by a suitable arrangement of the plan of his narrative, to introduce the lines whose recital had long since become familiar to him.

Evidence of design in the introduction of the "Shield of Achilles" certainly does not seem wanting.

It is not necessary to the plot of the "Iliad" that Achilles should lose the celestial armour given to Peleus as a dowry with Thetis. On the contrary, Homer has gone out of his way to render the labours of Vulcan necessary. Patroclus has to be so ingeniously disposed of that while the armour he had worn is seized by Hector, his body is rescued, as are also the horses and chariot of Achilles.

We have the additional improbability that the armour of the great Achilles should fit the inferior warriors Patroclus and Hector. Indeed, that the armour should fit Hector, or rather, that Hector should fit the armour, the aid of Zeus and Mars has to be called in—

> "To this Jove's sable brows did bow; and he made fit his limbs
> To those great arms, to fill which up the war-god enter'd him
> Austere and terrible, his joints and every part extends
> With strength and fortitude."
>
> Chapman's Translation.

It is clear that the narrative would not have been impaired in any way, while its probability and consistency would have been increased, if Patroclus had fought in his own armour. The death of Patroclus would in any case have been a cause sufficient to arouse the wrath of Achilles against Hector—though certainly the hero's grief for his armour is nearly as poignant as his sorrow for his friend's death.

It appears probable, then, that the description of Achilles' Shield is an interpolation—the poet's own work, however, and brought in by him in the only way he found available. The descrip-

tion clearly refers to the same object which is described (here, also, only in part) in the Shield of Hercules. The original description, doubtless, included all that is found in both "shields," and probably much more.

What, then, was the object to which the original description applied? An object, I should think, far more important than a warrior's shield. I imagine that any one who should read the description without being aware of its accepted interpretation, would consider that the poet was dealing with an important series of religious sculptures, possibly that he was describing the dome of a temple adorned with celestial and terrestrial symbols.

In Egypt, there are temples of a vast antiquity, having a dome, on which a zodiac—or, more correctly, a celestial hemisphere—is sculptured with constellation-figures. And we now learn, from ancient Babylonian and Assyrian sculptures, that these Egyptian zodiacs are in all probability merely copies (more or less perfect) of yet more ancient Chaldæan zodiacs. One of these Babylonian sculptures is figured in Rawlinson's "Ancient Monarchies." It seems probable that in a country where Sabæanism, or star-worship, was the prevailing form of religion, yet more imposing proportions would be given to such zodiacs than in Egypt.

My theory, then, respecting the Shield of Achilles is this—

I conceive that Homer, in his eastern travels, visited imposing temples devoted to astronomical observation and star-worship; and that nearly every line, in both shields, is borrowed from a poem in which he had described a temple of this sort, its domed zodiac, and those illustrations of the labours of different seasons and of military or judicial procedures, which the astrological proclivities of star-worshippers led them to associate with the different constellations.

I think there are arguments of some force to be urged in support of this theory, fanciful as it may seem.

In the first place, it is necessary that the constellations recognized in Homer's time (not necessarily, or probably, *by* Homer) should be distinguished from later inventions.

Aratus, writing long after Homer's date, mentions forty-five constellations. These were probably derived, without exception, from the globe of Eudoxus. Remembering the tendency which astronomers have shown, in all ages, to add to the list of constellations, we may assume that in Homer's time the number was smaller. Probably there were some fifteen northern and ten southern constellations, besides the twelve zodiacal signs. The smaller constellations mentioned by Aratus, doubtless formed parts

of larger figures. Any one who studies the heavens will recognize the fact that the larger constellations have been robbed of their just proportions to form the smaller asterisms. Corona Borealis was the right arm of Bootes, Ursa Minor was a wing of Draco (now wingless, and no longer a dragon), and so on.

Secondly, it is necessary that the actual appearance of the heavens, with reference to the position of the pole in Homer's time, should be indicated. For our present purpose, it is not necessary that we should know the exact date at which the most ancient of the zodiac-temples were constructed (or to which they were made to correspond). There are good reasons, though this is not the proper place for dwelling upon them, for supposing that the great epoch of reference amongst ancient astronomers, preceded the Christian era by about 2200 years. Be this as it may, any epoch between the date named, and the probable date at which Homer flourished—say nine or ten centuries before the Christian era—will serve equally well for our present purpose. Now, if the effects of equinoctial precession be traced back to such a date, we are led to notice two singular and not uninteresting circumstances. First, the pole of the heavens fell in the central part of the great constellation Draco; and, secondly, the equator fell along the length of the great sea-serpent, Hydra, in one part of its course, and elsewhere to the north of all the ancient aquatic constellations,* save that one-half of the northernmost fish (of the zodiac pair) lay north of the equator. Thus, if a celestial sphere were constructed with the equator in a horizontal position, the Dragon would be at the summit, Hydra would be extended horizontally along the equator—but with his head and neck reared above that circle, and Argo, Cetus, Capricornus, Piscis Australis, and Pisces—save one-half of the northernmost—would lie *below* the equator. It may also be mentioned that all the bird-constellations were then, as now, clustered together not far from the equator—Cygnus (the farthest from the equator) being ten degrees or so nearer to that circle than at present.

Now let us turn to the two shields, and see whether there is anything in them to connect them with zodiac-temples, or to remind us of the relations exhibited above. To commence with the Shield of Achilles, the opening lines inform us that there appeared—

> "The unwearied Sun, the Moon completely round
> The starry lights that heav'n's high convex crown'd,
> The Pleiads, Hyads, with the northern team,
> And great Orion's more refulgent beam."

* I exclude Delphinus as later than Homer's time, though mentioned by Aratus.

And here, in Achilles' shield, the list of constellations closes; but it is remarkable that in the Shield of Hercules, while the above lines are wanting, we find lines which clearly point to other constellations. Remembering what has just been stated about Draco, it seems, at the least, a singular coincidence that we should find the centre or boss of the shield occupied by a dragon:—

> "The scaly horror of a dragon, coil'd
> Full in the central field, unspeakable,
> With eyes oblique retorted, that aslant
> Shot gleaming flame."*
>
> Elton's Translation.

We seem, also, to find a reference to the above-named relations of the aquatic constellations, and specially to the constellation Pisces:—

> "In the midst,
> Full many dolphins chas'd the fry, and show'd
> As though they swam the waters, to and fro
> Darting tumultuous: two of silver scale
> Panting above the wave."

For we learn from both "shields" that the waves of ocean were figured in a position corresponding with the above-mentioned position of the celestial equator, beneath which—that is, *in the ocean*, on our assumption—the aquatic constellations were figured. The description of the ocean in the Shield of Hercules contains also some lines, in which we seem to see a reference to the bird-constellations close above the equator:—

> "Rounding the utmost verge the ocean flow'd
> As in full swell of waters, and the shield
> All variegated with whole circle bound.
> Swans of high-hovering wing there clamour'd shrill,
> Who also skimm'd the breasted surge with plume
> Innumerous; near them fishes 'midst the waves
> Frolick'd in wanton bounds."

In the Shield of Achilles no mention is made of Perseus, but in the Shield of Hercules this well-known constellation seems described in the lines—

> "There was the knight of fair-hair'd Danae born,
> Perseus; nor yet the buckler with his feet
> Touch'd nor yet distant hover'd, strange to see,
> For nowhere on the surface of the shield

---

* Compare the description of Draco by Aratus:—

> "Swol'n is his neck—eyes charg'd with sparkling fire
> His crested head illume. As if in ire
> To Helice he turns his foaming jaw
> And darts his tongue, barb'd with a blazing star."
>
> Lamb's Translation.

He rested; so the crippled artist-god
Illustrious fram'd him with his hands in gold.
Bound to his feet were sandals wing'd; a sword
Of brass, with hilt of sable ebony,
Hung round him from the shoulders by a thong.
. . . . . The visage grim
Of monstrous Gorgon all his back o'erspread;
. . . . . the dreadful helm
Of Pluto clasp'd the temples of the prince."

I think there is an obvious reference to the twins Castor and Pollux (the wrestler and boxer of mythology) in the words—

"But in another part
Were men who wrestled, or in gymnic fight
Wielded the cestus."

Orion is not mentioned by name in the Shield of Hercules as in the other; but Orion, Lepus, and the two dogs seem referred to:—

"Elsewhere men of chase
Were taking the fleet hares; two keen-toothed dogs
Bounded beside, these ardent in pursuit,
Those with like ardour doubling in their flight."

In each shield we find a reference to the operations of the year—hunting and pasturing, sowing, ploughing, and harvesting. It is hardly necessary to point out the connection between these operations and astronomical relations. That this connection was fully recognized in ancient times is shown in the "Works and Days" of Hesiod. We find also in Egyptian zodiacs clear evidence that these operations, as well as astronomical symbols or constellations, found a record in sculptured domes.

The judicial, military, and other proceedings described in the Shield of Achilles were also supposed by the ancients to have been influenced by the courses of the stars.

If we had no evidence that ancient celestial spheres presented the constellations above referred to, we might be disposed to attach less weight to the coincidences here presented; but the "Phenomena" of Aratus affords sufficient testimony on this point. In the first place, that work is of great antiquity, since Aratus flourished two centuries and a half before the Christian era; but it is well known that Aratus did not describe the results of his own observations. The positions of the constellations, as recorded by him, accord neither with the date at which he wrote nor with the latitude in which he lived. It is generally assumed—chiefly on the authority of Hipparchus—that Aratus borrowed his knowledge of astronomy from the sphere of Eudoxus; but we must go much farther back

even than the date of Eudoxus, before we can find any correspondence between the appearance of the heavens and the description given by Aratus. Thus we may very fairly assume that the *origin* of the constellations (as distinguished from their association with certain circles of the celestial sphere) may be placed at a date preceding, perhaps by many generations, that at which Homer flourished.

Indeed, there have not been wanting those who find in the ancient constellations the record of the early history of man. According to their views Orion is Nimrod—the "Giant," as the Arabic name of the constellation implies—the mighty hunter, as the dogs and hare beside him signify. The Centaur bearing a victim towards the altar is Noah; Argo, the stern of a ship, is the ark, as of old it might be seen on Mount Ararat. Corvus is the crow sent forth by Noah, and the bird is placed on Hydra's back to show that there was no land on which it could set its foot. The figure now called Hercules, but of old Engonasin, or the kneeler, and described by Aratus as "a man doomed to labour," is Adam. His left foot treads on the dragon's head, in token of the saying, "It shall bruise thy head;" and Serpentarius, or the serpent-bearer, is the promised seed.

Of course, if we accept these views, we have no difficulty in understanding that a poet so ancient as Homer should refer to the constellations which still appear upon celestial spheres. And, in any case, the mere question of antiquity presents, as we have already shown, little difficulty.

But there is a difficulty in one respect, a notice of which must close this paper, already carried far beyond the limits I had proposed to myself. It may be thought remarkable that heroes of Greek mythology, as Perseus and Orion, should be placed by Homer, or even by Aratus, in spheres which are undoubtedly of eastern origin.

Now it may be remarked, first, of Homer, that many acute critics consider the whole story of the "Iliad" to be, in reality, merely an adaptation of an eastern narrative to Greek scenes and names. It is pointed out, that, whereas the Catalogue in Book II. reckons upwards of 100,000 men, only 10,000 fought at Marathon; and, whereas there are counted no less than 1200 ships in the Catalogue, there were but 271 at Artemisium, and at Salamis but 378. However this may be, we have the distinct evidence of Herodotus that the Greek mythology was derived originally from foreign sources. He says, "All the names of the gods in Greece

were brought from Egypt," an opinion in which Diodorus and other eminent authorities concur. But it is the opinion of acute modern critics that we must go beyond Egyptian—to Assyrian, or Indian, perhaps even to Hebrew sources, for the origin of Greek mythology. Bryant traces nearly all the Greek myths to traditions of the dispersion of the Cuthites or Cuseans. And Layard has ascribed to Niebuhr the following significant remarks: "There is a want in Grecian art which neither I, nor any man now alive, can supply. There is not enough in Egypt to account for the peculiar art and the peculiar mythology which we find in Greece. That the Egyptians did not originate it I am convinced, though neither I, nor any man now alive, can say who were the originators. But the time will come when, on the borders of the Tigris and Euphrates, those who come after me will live to see the origin of Grecian art and Grecian mythology."

ON THE NEW THEORIES IN CHEMISTRY.

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No. IV.

We have seen, in the last article, that the molecule of most elements consists of two atoms, each having different and opposite properties, which in effect neutralize one another. If a molecule of hydrogen, H, H, be acted upon by a molecule of chlorine Cl, Cl, the result is two molecules of hydrochloric acid, H Cl, H Cl. If these molecules of hydrochloric acid be brought into contact with a molecule of sodium, a molecule of hydrogen is set free, and two molecules of chloride of sodium are formed, Na Cl, Na Cl; and if these be vaporized and acted upon by steam, at a high temperature, two molecules of hydrate of soda, Na HO, Na HO, will be the product, together with two molecules of hydrochloric acid.

$$Na\,Cl + Na\,Cl + 2(H_2O) = Na\,HO + Na\,HO + 2(H\,Cl).$$

In the first instance, an atom of chlorine has replaced an atom of hydrogen, in the free molecule; in the second, sodium has replaced the second atom of hydrogen; and in the third, HO (hydroxyl) has replaced an atom of chlorine. One of these compounds, Na Cl, is ordinarily called a salt, and in general parlance, common salt;

in its constitution it in no way differs from the other three compounds; so that in whatever sense it is a salt, the others are salts. We may, therefore, say that a salt is a body in which an equilibrium exists between its constituent atoms, whether those atoms exercise their properties individually or in conjunction; by this is meant, either as simple elements, or as compounds, acting permanently as elements, as CN and CN_6Fe, or for the time only, as radicals, as NO_3, SO_4, etc.; for, by acting on Na HO with H_2SO_4, SO_4 moves over *en masse* to Na, its hydrogen uniting with HO to form water; thus:

$$2(Na\ HO) + H_2SO_4 = Na_2SO_4 + 2(H_2O).$$

Usually, salts are defined to be the compounds formed by the neutralization of a base by an acid, either wholly or in part—a base being that substance which has alkaline properties, or which turns red litmus, blue or yellow turmeric paper brown, and which has a peculiar soapy taste; an acid being a substance which turns blue litmus paper red, and has a sour taste. This view originated when compound bodies were regarded as made up of two constituent parts—the base, or alkaline, and the acid; it was then thought that such compounds as sulphuric acid were formed by the union of water HO, and anhydrous sulphuric acid SO_3, and that these were simply joined together, and that sulphuric acid existed, as such, in a salt—say sulphate of soda—but that the properties of the acid were more or less neutralizing, in proportion to the excess or deficiency of base. Now, it is clearly shown that this view is incorrect, for SO_3 has not what are termed acid properties; it does not redden litmus paper; it is a solid, silky-looking substance, not unlike white floss silk; and, if the fingers be perfectly dry, it can be handled with impunity: but, when dropped into water, the union between it and the water is so energetic, that a sound, similar to that produced by melted lead poured into water, is produced. When united with water, it has acid properties, and no amount of heat can separate from it that water which it has taken up to form the compound, which was formerly represented by the formula HO, SO_3. No exception can be taken to the terms acid and base, if used in an adjective sense, expressive of certain properties. Thus, sulphuric acid is an acid, because it reddens blue litmus paper, and has what is called an acid taste; and potash is a base, because it turns red litmus paper blue, and has the peculiar taste of an alkali; and when the two are mixed, they, between them, form a salt—not that, after mixture, either of them exists in that salt, but only part of the constituents of each, they having lost two molecules of water, one of

which was necessary to give acid properties to the sulphuric acid, and the other alkaline properties to the potassium; potassium remains combined with SO_4, and the formula of the body is $K_2 SO_4$; not that this is intended to be the rational formula of the compound, or to express the way in which the elements are grouped together; for, if we take baryta instead of potash, we have the sulphate $Ba SO_4$, and this can be formed by precipitating a soluble baryta salt, such as barytic chloride, with sulphuric acid; thus:

$$Ba Cl_2 + H_2 SO_4 = Ba SO_4 + 2 H Cl.$$

But the same compound can also be formed by acting on the sulphite with chlorine water, for the hypochlorous acid in chlorine water gives up its oxygen to the sulphite, $Ba SO_3$, converting it into $Ba SO_4$; in like manner, sulphide of barium can, by oxidation with nitric acid, be converted into the sulphate. In all these several ways can the sulphate of barium be formed, and therefore it cannot be said to result from the union of two groups of atoms bonded together in some inseparable manner; its molecule, however, is in a state of equilibrium, and the way in which this condition exists will be better understood after the saturation of molecules and the theory of types have been considered.

This is, perhaps, the best place for noticing a new nomenclature which is fast coming into general use, and one which expresses the nature of compounds much better than the old names. It has not been hitherto used in these articles, which are intended especially for those who have not made the new chemical theories their study, as it would, before explanation, have thrown difficulties in the way of rendering them as plain as the nature of the subject will admit of. Sulphuric acid, being a sulphate of hydrogen, and not, as was formerly considered, a combination of water and sulphuric acid, the term sulphuric acid is replaced by hydric sulphate; and this fairly expresses the nature of the body, hydrogen being basic and SO_4 chlorous. The hydrogen can be replaced by other metals according to their valency, atom for atom, in the case of monovalent elements; thus, $Na HSO_4$, formerly called bisulphate of soda, is now hydro-sodic sulphate, expressive of the fact that it contains hydrogen, sodium, and SO_4; and $Na_2 SO_4$ is called sodic, or di-sodic sulphate. The nitrates, beginning with nitric acid HNO_3, consist of NO_3 and hydrogen, or other metals which can replace it; monovalent elements, taking the place of the one atom of hydrogen, form but one class of compounds, not two, as in $H_2 SO_4$, where there are two atoms of replaceable hydrogen; and divalent elements require two molecules

of the monobasic radical NO_3 to form nitrates; and trivalent elements, three molecules, etc. HNO_3, nitrate of hydrogen, is in the new nomenclature called hydric nitrate; and $AgNO_3$, nitrate of silver, argentic nitrate; and $Ba(NO_3)_2$, barytic nitrate. Hydrochloric acid is called hydric chloride; and Na Cl, common salt, sodic chloride. The three phosphoric acids are termed respectively, HPO_3 hydric metaphosphate, H_3PO_4 trihydric phosphate, and $H_4P_2O_7$ tetrahydric pyrophosphate. Rhombic phosphate of soda Na_2HPO_4 is named hydro-di-sodic phosphate, NaH_2PO_4 di-hydro-sodic phosphate, and Na_3PO_4 sodic or tri-sodic phosphate. It would occupy too much of our space to give all the changes which have been made; the illustrations of the different acids given will be sufficient to show the principle on which the changes have been made, viz., that of conveying by names a fair idea of the composition of the bodies which they are intended to designate. In Professor Williamson's "Chemistry for Students," this nomenclature is almost entirely employed.

Before concluding this brief statement of the constitution of compounds, it may be well to state that another view is held by some chemists, in which they regard salts, not as in a state of equilibrium, but as being bodies capable of undergoing, and ready to undergo, double decomposition; that is, as being in a state of unstable equilibrium. When carefully considered, the two views come to much the same thing, for at the moment a compound is formed it is in equilibrium, for the forces which have determined its composition must have proved superior to others with which it was previously in contact; and if all other forces could be withdrawn it would remain so, for it is only when, in contact, a greater force is brought to bear on its constituent elements than that which holds them together, that a decomposition can take place. No doubt the dynamical theory of the constitution of salts is true, but it does not seem to exclude the statical. The hydrated and anhydrous monoxides of potassium, sodium, etc., were formerly thought to differ from one another, in that the hydrated oxide was the anhydrous plus a molecule of water, the anhydrous oxide being represented by the formula KO, HO. If, however, KO, HO be heated to a white heat, it does not part with the HO. It has been shown, in a former article, that oxygen cannot combine with hydrogen in less proportion than two atoms of hydrogen to one of oxygen. Now, when potassium acts on water, the resulting compound is KHO, one atom of hydrogen, one of potassium, and one of oxygen, the second atom of hydrogen in the water being set free. The elements of water,

therefore, clearly do not exist in the hydrate; but changed water is there, so to speak—water which has changed one of its atoms of hydrogen for one of potassium; and this brings us to the way in which such compound bodies and their re-actions are now regarded. To Dr. Williamson we owe the method of viewing chemical decompositions, with reference to what is termed the water type, a system which gives a rational account of the interchanges and substitutions which take place when bodies re-act on one another. It should be understood that types are but representations, which have, perhaps, in some instances been carried to a somewhat fanciful extent; what is meant to be expressed by them is the bringing into view the re-acting substances by means of formulæ, and the expressing rationally the changes which take place between them. It is simply for clearness and convenience that they are written in a peculiar form; the same truths could be expressed if any other arrangement of the symbols were adopted.

Dr. Williamson took as the first type one molecule of water, which for convenience he wrote thus, $\frac{H}{H}O$; and on this type he says that most bodies can be represented which contain one atom of hydrogen, which can be replaced by a monovalent element such as potassium. For example, hydrate of potash, which is, as we have seen, water in which an atom of potassium has been substituted for one of hydrogen, is represented thus, $\frac{K}{H}O$; and anhydrous oxide of potassium, in which the other atom of hydrogen has been replaced by potassium, thus, $\frac{K}{K}O$. In these formulæ a rational account is given of the formation of these salts, and one which at a glance shows their constitution, and which is, moreover, truly in accordance with the method of their formation, and the type is not altered. The monobasic acid, nitric acid, is represented as being formed on the type of one molecule of water, by the substitution of a molecule of peroxide of nitrogen, NO_2, for one atom of hydrogen, $\frac{H}{NO_2}O$; and in like manner nitrate of potash is formed by the replacement of the other atom of hydrogen by potassium, thus, $\frac{K}{NO_2}O$; and that such is really what takes place is proved by the action of chloro-nitric acid, NO_2Cl, on water (chloro-nitric acid is formed by the action of chloro-phosphoric acid, $PO\,Cl_3$, on plumbic nitrate, $Pb(NO_3)_2$), for the radical NO_2 takes the place of one atom of hydrogen in a

molecule of water, which forms hydrochloric acid with the atom of chlorine in the acid; thus—

$$Cl\,NO_2 + \begin{matrix}H\\H\end{matrix}O = HCl + \begin{matrix}NO_2\\H\end{matrix}O.$$

And again, by the action of anhydrous nitric acid N_2O_5 on water—

$$\begin{matrix}NO_2\\NO_2\end{matrix}O + \begin{matrix}H\\H\end{matrix}O = \begin{matrix}NO_2\\H\end{matrix}O + \begin{matrix}NO_2\\H\end{matrix}O.$$

In both these cases nitric acid is formed by direct substitution of NO_2 for H. A similar interchange of NO_2 for H takes place when nitric acid acts on benzole, C_6H_6,

$$C_6H_6 + HNO_3 = H_2O + C_6H_5(NO_2),$$

resulting in the formation of nitro-benzole. This substitution of NO_2 is very frequent in organic chemistry, more so than in inorganic; it is the process by which cellulose is converted into gun-cotton, and, according to the strength of the acid used, as many as three molecules of NO_2 can be substituted for three atoms of hydrogen,

$$\underset{\text{(Cellulose.)}}{C_6H_{10}O_5} + (HNO_3)_3 = \underset{\text{(Gun-cotton.)}}{C_6H_7(NO_2)_3O_5} + 3(H_2O).$$

The explosive substance nitro-glycerine is likewise the product of a similar substitution.

Sulphuric acid, which is bibasic, is represented on the type of two molecules of water, $\begin{matrix}H_2\\H_2\end{matrix}O_2$, in which two atoms of hydrogen are replaced by the radical SO_2, called sulphuryl, $\begin{matrix}SO_2\\H_2\end{matrix}O_2$.

Dr. Williamson has shown* that the chlorous radicals, SO_2, NO_2, can be removed from salts as effectually as the basylous elements hydrogen and potassium. He made experiments by acting on sulphuric acid with penta-chloride of phosphorus; and succeeded in forming the body SO_2Cl_2, chloro-sulphuric acid. The decomposition takes place in two successive stages: the first consists in the replacement of hydroxyl, HO, by an atom of chlorine, forming SO_2HOCl; and the second by the replacement of the second hydroxyl by another atom of chlorine, forming SO_2Cl_2, thus showing that SO_2, the radical of sulphuric acid, is capable of replacing or is equivalent to two atoms of hydrogen, and proving the bibasic character of sulphuric acid.

* Proceedings of the Royal Society, vii. II.

Dr. Williamson says, "Had this radical been divisible like an equivalent quantity of a monobasic acid, we should have obtained a mixture, not a compound, of the chloride with the hydrate; or, at least, the products of decomposition of that mixture." When sulphuric acid is decomposed by a metal, if the acid be dilute, its hydrogen is replaced by the metal, as is seen in the preparation of hydrogen from zinc and sulphuric acid; but if zinc act on strong oil of vitriol under the influence of heat, sulphurous acid, SO_2, is given off, showing that it is held in sulphuric acid in a manner similar to hydrogen. $SO_2 Cl_2$ decomposes water with violence, if the acid be in excess, hydrochloric acid being formed by the replacement of two atoms of hydrogen in two molecules of water by SO_2.

$$SO_2 Cl_2 + 2 (H_2 O) = SO_2 H_2 O_2 + 2 H Cl.$$

And from this reaction, we must regard sulphuric acid as water, in which two atoms of hydrogen have been replaced by the direct substitution of the acid radical SO_2. In the same way alcohol, $C_2 H_6 O$, which in organic chemistry seems to take the place of water in inorganic, is water in which an atom of hydrogen has been replaced by an atom of the radical ethyl ($C_2 H_5$)—

$$\begin{matrix} H \\ H \end{matrix} O \qquad \begin{matrix} C_2 H_5 \\ H \end{matrix} O$$

and is a salt as truly as sulphuric acid or sulphate of soda. It is an oxide of hydrogen and ethyl, just as potash is an oxide of hydrogen and potassium; because for the second atom of hydrogen in water, not replaced by ethyl, potassium can be substituted by the action of that metal on vinic alcohol, just as hydrate of potash was formed by its action on water.

$$\begin{matrix} C_2 H_5 \\ H \end{matrix} O \qquad \begin{matrix} C_2 H_5 \\ K \end{matrix} O.$$

If the remaining atom of hydrogen in alcohol, which is called typical hydrogen, because it belongs to the typical water, be replaced by $C_2 H_5$, we have—

$$\begin{matrix} C_2 H_5 \\ H \end{matrix} O \quad \begin{matrix} C_2 H_5 \\ C_2 H_5 \end{matrix} O, \text{ or } C_4 H_{10} O, \text{ vinic ether,}$$

which corresponds to the anhydrous oxide of potassium, $\begin{matrix} K \\ K \end{matrix} O$, in which both atoms of the hydrogen of the water have been replaced by potassium, and may be called ethylic oxide, just as alcohol may be called hydro-ethylic oxide. That ether is really formed by the substitution of $C_2 H_5$ for H in vinic alcohol, and that it is formed on the type of a molecule of water, is seen when iodide of ethyl, $C_2 H_5 I$,

acts on potassium alcohol, $\frac{C_2 H_5}{K} O$; for if alcohol be water, in which one atom of hydrogen is replaced by ethyl, then the second atom can be replaced by potassium; and if iodide of ethyl (which is made by the action of phosphorous iodide on alcohol), be caused to re-act on it, a substitution of ethyl for potassium takes place, the iodine uniting with the ethyl; thus—

$$\frac{C_2 H_5}{K} O + C_2 H_5 I = I K + \frac{C_2 H_5}{C_2 H_5} O;$$

and this hydrogen is not only replaceable by ethyl, but by methyl, CH_3, by amyl, $C_5 H_{11}$, and by the other alcohol radicals, forming compound ethers; as $\frac{C_2 H_5}{CH_3} O$, vino-methylic ether, and $\frac{C_2 H_5}{C_5 H_{11}} O$, vino-amylic ether, which are obtained by the action of methylic iodide, $CH_3 I$, and amylic iodide, $C_5 H_{11} I$, respectively on potassio-vinic alcohol. The reverse of these reactions is also true, for when iodide of ethyl is treated with potassic hydrate, the potassium and ethyl change places, alcohol and potassic-iodate being formed—

$$\frac{K}{H} O + C_2 H_5 I = \frac{C_2 H_5}{H} O + K I$$

so that, indirectly, by the action of potassium on water, and by its replacement by $C_2 H$, we prove what we at first rather took for granted, viz., that alcohol is water in which an atom of hydrogen is replaced by the compound radical ethyl. If possible, a clearer proof of the constitution of ether is afforded by the constant process of Etherification, so ably explained by Professor Williamson in his paper in the "Philosophical Magazine." That process is effected by the action of sulphuric acid on alcohol; two parts by volume of alcohol are mixed with three of sulphuric acid, the heat evolved, which is considerable, causes the formation of sulpho-vinic acid, by the substitution of $C_2 H_5$ for H in the molecule of sulphuric acid; thus—

$$\frac{C_2 H_5}{H} O + \frac{H}{H} SO_4 = \frac{H}{H} O + \frac{C_2 H_5}{H} SO_4$$

(Sulpho-vinic acid.)

On raising the temperature to 135° C., the sulpho-vinic acid acts on another molecule of alcohol, in which the $C_2 H_5$ of the acid takes the place of the hydrogen in the alcohol; thus—

$$\frac{C_2 H_5}{H} SO_4 + \frac{C_2 H_5}{H} O = \frac{C_2 H_5}{C_2 H_5} O + \frac{H}{H} SO_4.$$

The further explanation of this process will be given in the next article.

* Phil. Mag. (3), xxxvii. 350.

ASTRONOMICAL NOTES FOR JUNE.

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In the month of June, all the large planets will be visible at some time in the course of the night, but three only of them in the evening.

Mercury will be at his greatest elongation on the morning of the 17th, being gibbous before that time and horned after it. He will set on the first day at 9h. 50m., or 1h. 45m. after sunset; on the 17th at 9h. 58m., or 1h. 42m. after sunset; and on the last day at 9h. 6m., or 49m. after sunset. Until quite the end of the month, therefore, he will be conspicuous in the evening, at first in the constellation Gemini, and afterwards in Cancer. On the 6th, he will be very near ϵ Geminorum, a star of the third magnitude; from the 16th to the 18th, he will be almost exactly south, by a few degrees, of the well-known twins, Castor and Pollux.

Venus is horned throughout the month. She will be constantly approaching the Earth, but as the proportion of illuminated surface turned towards us is becoming smaller, her apparent brilliancy, which will continually increase until June 9th, will, after that day, slowly diminish. She will set on the first day at 11h. 22m., then earlier each night until, on the last day, the time of setting will be 9h. 20m. On the 22nd she will be in conjunction with the Moon, then a *very* small crescent of only two days old, at 8h. 40m. in the evening. Early in the month she will pass from the constellation Gemini into Cancer, and continue there until the end of it; being stationary on the 24th, her right ascension will afterwards diminish instead of increasing as before.

Mars will be visible in the early morning, rising at the beginning of the month about half-past two, and at the end of it about half-past one. He passes, towards the end of the month, from Aries into Taurus, being near the Pleiades about the 27th. On the evening of the 17th, he is in conjunction with the Moon, and may, therefore, on the morning of that day be seen near her small crescent.

Jupiter will also be conspicuous in the mornings, rising, by the end of the month, a little before midnight. His position in the sky will be in the constellation Pisces, and he will be in conjunction with the Moon on the evening of the 14th. Next month we shall have occasion to commence calling attention to the more interesting of the phenomena of his satellites.

Saturn will be visible for the whole night throughout the month, rising on the first day at 6h. 51m. in the evening, and on the last day at 4h. 49m. He will be within a short distance of β Scorpii, a star of the second magnitude, about a degree to the north of it. On the 30th, he will be very near the Moon, being in conjunction with her on the morning of the 1st of July.

Occultations of stars by the Moon.—Four of these phenomena will, during the month of June, be observable within tolerably early hours of the night. They are as follows:—

Day.	Name of Star.	M.	Disappearance.		Reappearance.	
			Mean Time.	V.	Mean Time.	V.
			h. m.	°	h. m.	°
June 1	94 Virginis	6	7 20	42	8 35	241
„ 10	μ Capricorni	5	11 50	11	12 30	305
„ 27	48 Virginis	6	8 16	85	9 28	273
„ 30	η Libræ	6	12 45	40	13 8	2

The Moon.—The Moon will be full on the fifth day at 6h. 55m. in the morning. On the first evening or two, therefore, Kepler, and afterwards Aristarchus, may be studied with advantage. The tract known as the Mare Humorum, with Gassendi immediately to the north of it, will be at that time the most remarkable region in the more southern part of the Moon. As soon as the terminator has retreated a little in the waning Moon, the Mare Crisium will be found very interesting. The last quarter occurs on the morning of the 13th, the conjunction at 2h. 45m. on the afternoon of the 20th. The Mare Crisium may again be seen on the 24th, and shortly afterwards the Mare Fœcunditatis. On the 25th, Posidonius, preceding the advent of the Mare Serenitatis, will be in view; also Plinius on its southern boundary, and, in a more southern region of the Moon, the remarkable object called Theophilus. During the night of the 26th, Hipparchus, nearly in the Moon's centre, and the craters near Archimedes, will come into sight. The next morning (the 27th) at 5h. 51m., our satellite will be in her first quarter. Eratosthenes and Schröter will be visible in the evening, and Copernicus, with the Mare Imbrium to the north, on that of the 28th.

April Observations.—Although the night was, this year, not favourable for the observation of the April meteors, yet intelligence

has reached us that *some* were seen. It is as yet too early to state whether a result of any significance was arrived at.—Brorsen's comet was first seen by Professor Bruhns, at Leipzig, on the night of the 13th of April, and was observed the following evening by C. F. W. Peters (son of Prof. C. A. F. Peters), at Altona. It was, on April 14, very near ϵ Tauri, and was somewhat less than a degree distant from the place assigned to it by Bruhns' ephemeris. In appearance it was pretty bright. It is not probable that it will be visible, even with powerful object-glasses, in any part of June.

Recent Announcements.—Allusion should be made here to a recent new determination of the parallax of that bright star in the southern hemisphere, *a* Centauri, which has been executed by Prof. Moesta, Director of the Observatory at Santiago, in Chili, and published in the "Astronomische Nachrichten" (No. 1688). It is founded on more than two hundred observations made with the meridian-circle of that observatory, and extending from October, 1860 to May, 1864. It is well known that this is the nearest of all the fixed stars (at least, of those of which measurements of distance have been attempted), and is not much more than half the distance of that famous star in our own hemisphere, 61 Cygni. Henderson's observations at the Cape of Good Hope (corrected by Peters) gave a parallax of $0''{\cdot}976$; Maclear's, at the same place, of $0''{\cdot}919$. The result now arrived at by Moesta is $0''{\cdot}88$, with a probable error of $0''{\cdot}068$. It may safely be assumed, therefore, that the actual parallax is about nine-tenths of a second, which would give a distance of somewhat more than twenty-one billions of miles.

Encke's Comet.—This very remarkable comet is now again approaching the Earth. It is expected to be visible (but only by the help of powerful object-glasses) towards the end of June, in the constellation Aries. During the months of July and August it will be continually approaching the Earth, and become more generally seen, though probably always telescopic, and very faint. A few words may be here devoted to its previous history, which is, however, pretty well known to all who take any interest in astronomy.

It appears to have been first seen by Méchain, in the year 1786, and was afterwards re-discovered by Miss Herschel, in 1795; by Thulis, Pons, and others, independently, in 1805; and by Pons again, in 1818. On the occasion of the latter appearance (when it passed its perihelion in January, 1819), it was taken in hand by the illustrious late Director of the Berlin Observatory, Professor Encke, then only assistant at Seeberg, near Gotha. In a paper, printed in the

"Berliner Astronomisches Jahrbuch" for 1822, he showed that the successive discoveries above-mentioned were, in fact, those of the same comet, which revolved round the Sun in little more than three years, and had, consequently, since 1786, passed its perihelion on seven other occasions, without being seen. He predicted that it would return to perihelion in May, 1822. And, indeed, it was observed in June that year, by Rumker, at Paramatta, near Sydney, in Australia; also, at the next appearance in the autumn of 1825, by several observers in the northern hemisphere. The completeness of Encke's investigations led astronomers by common consent to call the comet after his name, though he himself always continued to call it Pons's comet. Following it up at subsequent appearances, he established the remarkable fact (which he conjectured even so early as 1819), that it is subject to some resistance in its motion which continually retards its progress, and slightly diminishes its periodic time. This would appear to be due to the ethereal medium which, we have every reason to suppose, pervades all space, and which, powerless to any sensible extent upon the planetary masses, is able to produce appreciable effects upon the motions of this tiny body; for Encke found, after carefully allowing for all other causes of disturbance, that the comet was subject to an additional opposing force of a purely tangential nature. The effect is, that the attraction of the Sun upon it becomes continually more powerful in comparison with its own projectile force, so that it approaches the Sun more nearly each revolution, and, having thus a smaller distance to traverse, accomplishes it in a shorter time. The amount of this is about 0·11 of a day, or $2\frac{1}{2}$ hours; so that whereas the period from the perihelion passage in 1819 to that in 1822 was 1211·66 days, that from the last perihelion passage in 1865 (at which appearance the comet was seen only in the southern hemisphere) until the forthcoming one this summer, will be only 1210·11 days.

The usual appearance of Encke's comet is that of a simple nebulous luminosity, of the diameter, when greatest, of nearly one third of a degree, with a necleus sometimes comparable to a star of the fifth magnitude (and, therefore, on some occasions visible to the naked eye), and a little tail, which occasionally shows itself towards the epoch of perihelion passage. One of the apparitions at which it was most favourably situated for observation, was that in the autumn of the year 1838. That return was also remarkable for the comet's having made a near approach to the planet Mercury, which furnished the means, by the perturbing effect upon the motions of

the comet, of determining, with considerably greater exactness than had previously been possible, the mass of the planet.

The most remarkable appearance, however, of this comet was that which occurred in 1848. In November of that year it again made a near approach to Mercury, the orbit of which is exterior to part of that of the comet, and came within little more than three millions of miles of that planet. Some interesting observations were made during the appearance of that year, of which the most so were those of the late Professor W. C. Bond, at Cambridge, Massachusetts. We extract the following remarks from them, as published in the "Monthly Notices of the Royal Astronomical Society."*

"1848, August 27th. The comet is faint and without concentration; its light is coarsely granulated, so that, were it not for its motion, it might be mistaken for a group of very small stars.

"September 26th. A faint brush of light extends from the comet *towards* the Sun.

"October 6th. The comet is just visible to the naked eye. The brighter part is very eccentrically situated with reference to the general mass. A fan-shaped brush of light is very evident on the side *towards* the Sun. There is no other appendage which can be called a tail.

"October 27th. A faint ray of light is now seen directed *from* the Sun.

"November 3rd. The comet shows a tail of one or two degrees directed *from* the Sun; with the same appearance on the opposite side as in October."

We hope on some future occasion, but want of sufficient space now forbids, to have an opportunity of entering a little into the theories which have been started and discussed at various times to account for the phenomena presented by comets—remembering the truly just remark of M. Le Verrier, "It is well that views, which have even been hazarded on some points, should be brought forward concerning phenomena so complicated and hitherto unexplained; and provided attention be properly called to doubtful points in them, science cannot but gain by their discussion." That both attractive and repulsive forces are manifested between the Sun and comets is evident, and the oscillatory motion of the particles which are frequently seen to stream out from a comet towards the Sun, indicates the existence of a force of a polar character, as was many years ago remarked by Bessel. Study and observation will doubtless, as in so

* Vol. ix., p. 106.

many other instances, throw much additional light upon the appearances presented by these remarkable bodies. Spectrum analysis has here also been called in to our aid, and will be again when opportunities are afforded. Quite recently also the connection which identity of orbit between some comets and meteors appears to make probable, and the elaborate investigations into cometary systems (founded upon ideas which had suggested themselves to him) by Professor Hoek of Utrecht, have given hopes of leading to very interesting results. Laborious and persevering observation, readiness to examine any ideas which may be thereby suggested, and to abandon any idea as soon as it is shown to be inconsistent with facts, are necessary to all who would take a part in the advancement of science, and who desire to arrive at tenable conclusions in any of its departments.

THE MELBOURNE TELESCOPE.

THE Committee on the Melbourne Telescope—Earl Rosse, Dr. Robinson, and Mr. Warren De La Rue—have just made a most favourable Report to the Royal Society on the construction and performance of this great instrument. There can, we apprehend, be no doubt that Mr. Grubb, of Dublin, has brought great ingenuity and skill to bear upon its construction and mounting, and that it is in many respects far more convenient and manageable than any other monster telescope hitherto made.

The Melbourne authorities took counsel with the Royal Society and—notwithstanding the merit of Mr. Grubb's performance—we shall be much surprised if they do not find reason for regretting that they were guided by the somewhat old-fashioned ideas which that learned body brought to bear on the solution of the question—"What sort of telescope shall it be?"

Metallic reflectors must now be considered as out of date. They are much more costly than the silvered glass mirrors introduced by Foucault, they reflect considerably less light, are much heavier, and, when their polish is lost, do not admit of reparation, except at a great expense, as the re-polishing is nothing short of re-figuring, which is a costly and delicate operation. Re-silvering a glass mirror costs little, and does not demand unusual skill.

The focal length desirable for a telescope depends upon its aperture, and as a larger aperture is required to get the same

amount of light from a metallic mirror, than from a silvered-glass one, it follows that the former will have a longer tube, with the inevitable result of additional vibration. It is mechanically impossible to make a long tube as steady as a shorter one; and although Mr. Grubb has evinced a high degree of skill in the mounting of his instrument, it is only necessary to inspect a photograph of it, in order to be convinced that a little wind must produce considerable motion. The point of suspension is near the mirror, on account of its immense weight, and in front of this point the telescope stretches forward to about thirty feet of open lattice tube-work, made of bands of elastic steel. The Royal Society's Committee give us no information as to the results of this arrangement, though it would be most important to know the actual amount of vibration produced by moderate air currents and changes of adjustment. In heavy winds, we presume, no one would expect a huge instrument to act well.

The telescope is on Cassegrain's plan, with the eye-piece, as in the Gregorians, at the bottom, and very convenient for use. The adjusting-apparatus, which is reported to work well, is brought close to the observer, and the mirror is stated to be very accurately and ingeniously suspended, as we might expect, from Mr. Grubb's reputation.

Practical opticians consider the Cassegranian form a very difficult one to make accurately; the curves of the large and small mirrors requiring the nicest mutual adaptation and adjustment. It would have been interesting to know, from experiment, whether this form, when the smaller mirror is at the end of a very long elastic steel lattice tube, suffers more derangement from vibration than a Newtonian does. It seems probable that such would be the case.

The telescope must be a fine one of its class, or it could not do anything like what the Committee report. They found "that the light even of large stars was collected into small, hard, and perfectly circular disks, free from rays, and though some diffused light surrounded them, it was exactly concentric with the central disks." In a note we are told that "the cause of this diffused light has since been discovered and removed." This would leave nothing but the clear hard disks to be seen, and as that is an optical impossibility, we presume the Committee either did not know of the insertion of this note, or were in a singularly approving frame of mind. There is nothing wonderful in the fact, "that the fifth and sixth stars of the trapezium in Orion were not only plainly seen,

but were very bright," in a telescope with a mirror four feet in diameter, nor that such an instrument showed ζ Orionis well; and even its splitting γ^2 Andromedæ with powers of 350 and 450 is not surprising, as the same feat has been performed with a With-Browning silvered-mirror telescope, $6\frac{1}{4}$ inches in diameter, and is not at all difficult, on good nights, for sizes a few inches larger of the same construction. The light-collecting power is stated to be very satisfactory. "The planetary nebula in 46 M. was revealed as a ring bright even as the dazzling ground of the surrounding stars, which were as brilliant as the Pleiades appear in ordinary instruments."

At present much interest is excited in the question of changes, or alleged changes, in nebulæ, and in minute details of planetary markings. For both these purposes extreme steadiness, as well as great optical power and accuracy, is necessary, and we shall wait with interest to know how far Mr. Grubb has succeeded in this very difficult but most important requisite.

We are glad to observe that Mr. De La Rue recommends that a photographic apparatus should be fitted to the telescope before it leaves Ireland.

A NEW ROTIFER WITHOUT CILIA—*BALATRO CALVUS*.

BY PROFESSOR ED. CLAPAREDE.*

UNDER the name of *Apsilus lentiformis*, M. Mecznikow† has recently described a rotifer totally destitute of vibratory cilia. The absence of cilia in an animal of this description is almost new to science,‡ and worthy of attention. In fact, till lately, the existence of a vibratory apparatus has been considered by most authors as a characteristic indispensable to a rotifer. We cannot, however, hesitate to accept M. Mecznikow's decision in favour of classifying his genus *Apsilus* amongst the rotifers. Those who are doubtful would be convinced by an examination of the young individuals which he describes, for they at least do possess the cilia characteristic of this zoological group; and the absence of these organs amongst the adults can only be regarded as a case of repressive metamorphosis.

The publication of M. Mecznikow was less surprising to me than to many others; in fact, for several years I have been acquainted

* Translated from the "Annales des Sciences Naturelles"; sent by the author.

† "Zeitschrift Wissenchaft, Zoologie, 1866." Band xvi., p. 346.

‡ See last paragraph, where M. Claparède acknowledges Mr. Gosse's investigations of Taphrocampa, and those of Dujardin on Lindia.

with a rotifer entirely destitute of vibratile cilia. I did not describe it sooner, hoping to find opportunities for a more profound study of it. The animal is, however, not common, and the memoir of M. Mecznikow has induced me to refer to my old sketches.

The rotifer in question has nothing in common with the *Apsilus lentiformis*. I found it in the Seime, a little river in the canton of Geneva, where it crawled over the bodies of small Oligochætans. I gave it the name of *Balatro calvus*.* The animal is more or less vermiform. (Figs. 1 and 2.) Its body is very contractile and variable in all its outlines. The posterior extremity, corresponding with

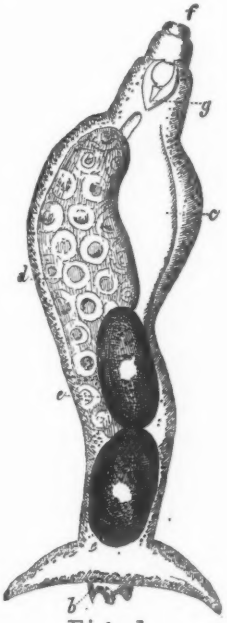


Fig. 1.

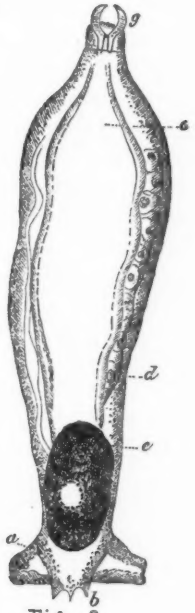


Fig. 2

what is called the foot of other rotifers, is divided into two lobes, one vertical the other dorsal. The first has a semi-lunar form. It has thus a convex side, a rectilinear side, and two angles. The rectilinear side is disposed transversely, and looks backward. The

* The parasite Balatro would no more leave Mæcenas than his shadow. In like manner this rotifer will not leave the bodies of the Oligochætans:

Summus ego, et prope me Viscus Thurinus et infra
Si memini Varius, cum Servilio Balatrone
Vibidius, quos Mæcenas adduxerat umbras.—Hor.

two angles are very acute, and can be retracted, invaginating themselves like the finger of a glove pushed inwards. (Fig. 2 *a*.) The upper lobe is a flattened cylindrical process, terminated by thin, small projections. The anus is situated between the two lobes.

The anterior extremity of *Balatro calvus*, vaguely annulated, is susceptible of retraction into the interior of the creature, as in other rotifers. By its transparency we then see the mastax relatively feebly developed, armed with a very small incus, and two hooked mallei. It opens directly into an intestine with thick walls, the internal layer of which is of a brown colour. The digestive tube is more simple than in most other rotifers, it extends in a straight line from the mouth to the anus. The anterior portion, a little narrower than the rest, scarcely deserves the name of an œsophagus. I have seen no traces of the glands so usually annexed to the stomachs of creatures of this class. When the animal stretches itself out, and protrudes its proboscis, the curved jaws project beyond the body. There are not even rudiments of cilia to be seen in the region of their proboscis.

All the individuals I observed were females. The ovary occupied the ventral side of the body, below the intestine (Fig. 1). The ripe eggs are ovoid, and lie at the posterior end of the body. Is there a system of secretory canals? I am not quite certain of this matter. I have not studied the nervous or muscular systems. There is no eye spot or antenna.

Genus Balatro. Rotifer with vermiform body, very contractile; posterior extremity terminating in two lobes, one ventral, semi-lunar, and transverse; the other, dorsal, approximately cylindrical, acting as a foot, mallei hooked, no vibratile organs, no eyes. Species: *Balatro calvus*, Clprd., habitat, the Seime, canton of Geneva, crawling upon mud-inhabiting Oligochætæ.

M. Claparède remarks, that Mr. Gosse had, long before these observations, or those of M. Mecznikow, described Taphrocampa, a rotifer without vibratile cilia. He objects to Mr. Gosse's recent classification of this genus amongst the *Gastrotricha Chetonotidæ*, or "hairy-backed animalcules." Dujardin had, previous to Mr. Gosse, described his Lindia as a rotifer without cilia.

DESCRIPTION OF CUTS.

Fig. 1.—*Balatro calvus* in supination. *a*, inferior caudal lobe (semi-lunar); *b*, upper caudal lobe; *c*, digestive tube; *d*, ovary; *e*, ripe eggs; *f*, mouth; *g*, jaws.

Fig. 2.—The same in pronation, similarly lettered.

CORRESPONDENCE.

INDIAN LEPIDOPTERA.

(*To the Editor of* THE STUDENT.)

IN Drew Drury's "Exotic Insects," vol. i., plate xxiv., p. 45, a singularly beautiful Nocturna, of the family Bombycidæ, is described under the generic and specific name of *Actias luna* (synonym *Phalæna* (*Attacus*) *luna*), of which he gives the following diagnosis:—"Upper side: antennæ brown and strongly pectinated, the head white, small, and almost hid under the shoulders and neck, having a small brown ring encircling it; thorax pale yellow, having a chocolate or dark brown line crossing it, parallel with the margins of the anterior wings. All the wings are of a beautiful pea-green colour, the nerves being of a pale red-brown. Along the anterior margin of the anterior wings runs a chocolate line, which is narrowed towards the tips. About an inch from the shoulders springs, from this line, a small curved one, which, bending towards the middle of the wing, terminates in a small eye, pointed in the lower part, whose pupil is transparent, like glass; the iris being partly red and partly black, within which are semicircles of white. External margin of the wings red-brown, the posterior being white. Posterior wings furnished with two broad tails, which at their extremities appear as if they were crimped, their external edges being red-brown; in the middle of each of these wings is likewise an eye, similar to, but rather larger than, those in the anterior ones. Abdomen white. Under side: abdomen white, the sides being of a dark clay colour; wings of the same colour as on the upper side, the nerves being brown and more conspicuous, without the brown edge on the anterior pair; the eyes same as above. Anterior margin of the inferior wings is white, and the eyes strongly resemble those of an animal having them half shut." Drury's correspondent informed him that the caterpillar of this handsome moth is red, and feeds on the leaves of the Sassafras tree. When they are full fed, they enclose themselves in a strong case composed of the substance of the tree and a glutinous matter, which they secrete. The caterpillar, however, figured by Abbot is green, with short hairs scattered over the body, and with about eight small red spots on each segment, placed transversely. So much from my edition of Drew Drury's work, which assigns the habitat as "New York, Carolina, Virginia, Maryland." In reading Sir Emerson Tennent's "Natural History of Ceylon," I found a moth described which seemed to approach very nearly to the description given above, and have since had the good fortune to take two very magnificent specimens on the continent of India, differing slightly, but markedly, from the North-American species of *Actias*. The first I found in a hedge at Coonoor, on the Nilgherri Hills, in the month of August; the second on a tree in my

garden at Kampti, in Central India, about the same time of the year. Both were very sluggish and dull, allowing themselves to be taken without an attempt to fly. The second one was so full of large eggs (which I dissected out), that they were bursting through a fistular opening in the side of the abdomen. I am induced to give you this account, because, finding them at so great a distance apart, and both in the hill region and in the plains of India, I should conclude that they are widely diffused over the country; and yet, though I have shown them to several intellectual observers of nature, and to two or three industrious collectors, they do not appear to be generally known, so that I conclude they are nowhere very abundant. The general shape, the curious long, broad crimped tails to the posterior wings, and the beautifully delicate pea-green colour of my specimens, correspond with what Drury describes, and very closely with what he figures, with the following exceptions—the strongly pectinated antennæ are a *very* pale brown; there is no yellow on the thorax, but thorax, abdomen, and the inner margin of the wings are densely covered with a pure white silky down; the brown madder markings over the veins are very faint and little seen, except with a very oblique light. The bent line leading from the margin of the wing to the eye on the anterior pair is also entirely absent; but a narrow faint line of slightly deeper colour runs all round the external edge of the rings, about a quarter of an inch from the margin. One of my specimens measures six and a quarter inches from tip to tip of the expanded wings, and four and a half inches from the head to the extremity of the broad tails of the posterior wings; the legs are strong, and of a reddish madder brown colour; eyes large, black, and rather prominent. The specimen that I took on the Nilgherri Hills was on a bush of *Symplocos nervosa;* the one that I took in the plains was on a small tree of *Ægle marmelos.* But this, perhaps, says nothing as to the food of the larva, except that the one last mentioned seemed ready to deposit her eggs. I have not had the good fortune to discover the caterpillar, or, to my knowledge, the cocoon; unless I can attribute to this insect some very large ones which I saw (but all abandoned) some years ago in the jungles in Coorg. Drury's remark upon the resemblance of the ocellated spots on the wings to the half-shut eyes of an animal, applies very well to these East Indian specimens.—JOHN E. HALLIDAY, Lieutenant-Colonel.

[Col. Halliday's insect and the closely allied American species to which he refers, now belong to Hübner's genus *Tropæa.* The Indian species is *T. Selene,* Hübner (Verz. Schmett., 152, 1588), described and figured by McLeay, under the name of *Actias Selene,* in Leach's Zool. Misc., ii., pl. 70. The larva is described and figured by Hutton, in Trans. Ent. Soc. Lond., v., 45, pl. 5, fig. 11. The insect, which is very variable in size, appears to be not uncommon, and to be widely distributed, occurring at Nepaul, Silhet, North China, Ceylon and Java (Dr. Horsfield).—ED.]

PROGRESS OF INVENTION.

LIFE BUOYS.—It is a slow and troublesome process to blow up an ordinary life buoy, and one can easily understand the difficulty which would be experienced in doing it when under the influence of fear from danger of drowning and sudden and unexpected immersion in water. To render a life buoy self-inflating is therefore most desirable, and Mr. J. S. Hood has succeeded in doing so. The buoy is made of india-rubber, or some such air-tight elastic material (he prefers to use vulcanized india-rubber), its shape is annular, and in its ordinary state it would be expanded and full of air; when not required for use, the air is to be pressed out, and the stop-cock, with which it is supplied at its neck, closed. In this condition it can be worn round the person, and when desired, by opening the stop-cock, the elastic sides expand and the vessel becomes filled with air. Nettings are in some cases fixed round the edge of the buoy, thereby enabling others to save themselves, as well as the person wearing it.

METHOD OF PRESERVING MEAT.—To destroy animal germs in meat, Mr. Theophilus Redwood heats it in parafine in a strong vessel, with an air-tight cover securely fastened down, raising it to 270° or 280° F.; he keeps it at that temperature for about half an hour, the juices being confined, and the steam generated, assist in raising the temperature; after this it is allowed to cool gradually. To cause a more perfect exclusion of air, he adds to the parafine coating, which is liable to crack or peel off, another, of a transparent material, which will allow of the meat being seen through it; this coating is made of gelatine, to which he adds sugar or glycerine, or even both if required, in such proportions that when dried it may be flexible and elastic. The proportions in which he uses these substances are as follows: six pounds of gelatine, in from twelve to fifteen pounds of water, dissolved by heat in a water bath, and two pounds of glycerine, or one pound of glycerine and one of sugar or gum is added. The mixture, thus prepared, is to be applied while fluid by heat; but not so hot as to melt the parafine which has been previously applied.

PREPARING AND PRESERVING STYPTIC PAPER.—M. Gustave Gabillon, of Paris, has discovered a method to render more effectual and convenient of application, and, at the same time, preserve the hæmastatic properties of perchloride of iron, or, as it is sometimes called, muriate of iron. It is well known that this substance possesses these properties in a high degree, and paper, or any tissue prepared with it, instantly stops bleeding when applied to wounds. It is inconvenient to carry about the solution of ferric chloride, nor is it easy to apply it. M. Gabillon's invention consists in his method of making and preserving the paper. He first dries, and then coats the paper or other tissue used with a protecting composition, to prevent its destruction by the perchloride of iron. The method

of application is as follows: the paper is first dipped in a solution made of one pound of gum benzoin of the first quality, one pound of rock alum, four and a third gallons of water; this mixture is heated in a vessel, carefully tinned inside, up to the boiling point, and the solution is to be kept boiling for four hours, and skimmed from time to time. The water evaporated is to be replaced by the same quantity of fresh water, and, as soon as the solution has cooled, it is to be filtered off. The paper or tissue is then to be dipped into it, and to be kept there till sufficiently saturated; it is then to be carefully dried. When dry, a solution of perchloride, in a more or less concentrated state, is applied by a brush or roller. The paper or tissue thus prepared is folded up and preserved from the action of the air by wrapping it in a piece of waterproof taffeta, prepared with the addition of resinous substances, and in this manner it can be preserved any length of time in a state always ready for use.

Treatment of Nitro-Glycerine by M. Alfred Nobe of Paris.—If nitro-glycerine be mixed with inexplosive porous substances, such, for instance, as charcoal or silica, it becomes very much altered in its properties. Thus, for example, nitro-glycerine alone is not inflammable by a spark, but may be made to explode by submitting it to the rapid action of a shower of sparks. Nitro-glycerine absorbed by porous substances easily catches fire from a spark, but burns away slowly, and without explosion, except it be kept in close confinement, in which case it explodes violently. The above mixture is also less sensitive to shocks and blows than nitro-glycerine by itself. Owing to its peculiar properties, this mixture, in blasting sound rocks, requires only the ordinary safety fuse; but in shattered rocks, or coal, it will cause no real explosion at all, as the gas will leak out through the crevices; for this reason a special igniter is used to explode it in fissured rock, or wherever it is not in *close* confinement, and this special igniter consists of a kind of percussion cap, in which the fulminate is caused to develope a very high gaseous pressure before it bursts, which may be attained either by increasing the charge of the fulminate, or diminishing the leakage of the gas before the cap bursts; this cap is adapted to the end of a safety fuse, by which it is ignited.

Improvements in Fire-Grates.—Some time ago it was recommended to place an iron plate at the bottom of a fire-grate, to light the fire from the top, and to leave it undisturbed. Many who tried the experiment found it to answer tolerably well, and that, by it, considerable saving of coal was effected. There is, however, this objection, that the kindling of the fire is slow, and that when a brisk fire is desired it cannot be obtained, for by poking the very opposite effect is produced. Mr. J. McOwen, of Rochdale, has patented a new grate, which seems to possess all the advantages and none of the disadvantages attending the use of the iron plate. He makes a box, on the top of which is a fine grate for the fire to

rest upon, and at the bottom is a coarse grate; in the box between the grates a sliding valve is placed, which can be opened or closed at pleasure; by this means the supply of air to the fire can be regulated by opening or closing the valve, and in this manner the quantity of coal consumed in a given time can be regulated, and so the fire can be made bright or dull at pleasure.

Manufacture of Iron and Steel.—Mr. Richardson, of Glasgow, has invented and patented a process for burning out the carbon from the crude metal. It consists in the introduction of a current of atmospheric air, introduced into the molten crude metal. When the ore is reduced in the blast-furnace, it is run off into a proper vessel; a blast of air at a pressure of four pounds on the square inch or upwards is introduced into the melted mass, through a hollow rabble or stirring-rod of a size suited to the mass to be decarbonated. The effect is that the impurities are rapidly driven off, and the metal obtained is specially adapted for producing castings of high quality. It may be run into moulds immediately after purification, or it may be cooled and afterwards melted for casting, and for this purpose it may be used alone, or with a portion of pig-iron or spiegel-eisen, or with any other compound of carbon and iron, which may be mixed with it in the molten or solid state, according to the temperature of the liquid metal in the receptacle. Crude steel may also be produced by the same process, and to get a finer steel, after the metal has been purified in the manner described, it may be run off into a chamber of a puddling-furnace, where unmelted spiegel-eisen or other compound of iron and carbon is added to it, to recarbonize the metal and so convert it into steel, which may be run off into ingot moulds. To insure thorough admixture of the carbonized compound with the purified melted metal, the charge is stirred up in the puddling-chamber with an ordinary rabble, and if desired powdered manganese, or other oxidizing compound, may be added through a tubular rabble previous to the addition of the carbonized compound of iron. If desired, steam may be used as the oxidizing agent.

A New Stopple for Soda-Water Bottles.—A very ingenious and useful stopple for soda-water bottles has been patented in America. It is much more simple, and less likely to get out of order, than the piston, and seems calculated to be quite as efficient, where it is required to take portions of soda-water from a bottle without allowing the carbonic acid to escape from the remainder. It consists of a globe of india-rubber, with a hole through its axis, the orifices being protected from wear by metal eyelets. Round the neck of the bottle is twisted a wire spring, which is passed through the india-rubber sphere, and keeps it in position over the mouth of the bottle, which it effectually stops. By the pressure of the thumb on the side of the stopple it can be pushed aside to allow the liquid to pass out; on removing the pressure it immediately returns to its place, the tension of the spring keeping it firmly fixed.

BOTTLES HERMETICALLY SEALED.—Gelatine mixed with glycerine yields a compound, liquid when hot, but becoming solid on cooling, at the same time retaining much elasticity. Bottles may be hermetically sealed by dipping their necks into the liquid mixture, and repeating the operation until the cap attains any thickness required.

DR. BRUNETTI, of Padua, who obtained the gold medal at the Paris Exhibition, has given a description of his process for preserving anatomical specimens to the International Medical Congress. It comprises four operations, viz.: 1st, the washing of the piece to be preserved; 2nd, the dégraissage, or eating away of the fatty matter; 3rd, the tanning; and 4th, the desiccation. 1. To wash the piece, water is passed through the blood-vessels and the various excretory canals, and the water is washed out by alcohol. 2. For destroying the fatty matter, ether is passed through the same vessels; this part of the operation lasts for some hours. The ether penetrates the interstices of the flesh, and dissolves all the fat. The piece at this point of the process may be preserved any length of time desired, kept in ether, before proceeding to the final operations. 3. For the tanning process, tannin is dissolved in boiling distilled water, and is then, after washing out the ether, injected into the vessels and tissues. 4. For the drying process, Dr. Brunetti places the pieces in a vase with a double bottom, filled with boiling water, and he fills the places of the preceding liquids with warm dry air. The air is dried by passing it over chloride of calcium, it is then passed through a heated chamber, and from thence through the vessels and ducts of the specimen, the air being dried and heated, and forced into the preparation under a pressure of two atmospheres. In this way he gets rid of all moisture in a very short time. After this treatment the piece remains supple, light, preserves its size, its normal relations, and its solid elements. It may be handled without fear, and will last for a very long time.

A NEW METHOD OF PREPARING TARTARIC ACID.—Tartaric acid is ordinarily prepared from a substance called argol, which is deposited at the bottom of wine-vats, and is, from the scarcity of the material, of considerable value. On account of this, Juette et De Pontéves made a series of experiments on the skins of grapes, which have up to this time been used only as manure. His method of preparing tartaric acid is as follows:—He boils the skins with two per cent. of sulphuric acid for some hours; this changes the sugar and part of the cellulose into grape sugar, and sets free the tartaric acid. After fermentation, a considerable quantity of spirit is obtained by distillation, and the tartaric acid is precipitated as a lime salt, from which it is set free by the action of sulphuric acid.

PREPARATION OF VARNISHES WITH TAR.—Varnishes, made according to the process discovered by Dr. G. Lunge, are especially useful for preserving iron; they are of different kinds, and adapted either to rough or highly-finished iron-work. Dr. Lunge melts pitch in an iron vessel;

when it is cold, but still fluid, he adds heavy tar oil; the whole being thoroughly mixed. The necessary quantities are easily found by practice. This varnish, which is as cheap as common tar, will dry in one or two days. For preparing a quicker drying varnish, a quantity of tar-oil of a higher boiling point is added to the melted and cooled pitch. Fine castings or ornamental wrought iron-work, may be varnished with a mixture made in the same way, in which naphtha is substituted for the heavy tar oils. This varnish will dry in a quarter or half an hour. These varnishes are much better than common tar, which contains ammonia, and, when applied cold, causes oxidation; they also possess greater power of penetration than boiled tar, and are therefore better adapted to wood or absorbent substances.

Paraffine as a Lubricator for Machinery, exposed to a High Temperature.—A sort of paraffine, which becomes soft at 15° to 20° C., can be obtained at a low price; it is soluble in fat oil, insoluble in water, and can be distilled without decomposition at 370° C. The advantages of its application to machinery are as follows:—While the machine is in action the paraffine is very fluid, and flows easily; any of it which may be carried away by water-vapour will be found, when cold, in lumps in the upper part of the condenser, from which it can easily be collected and removed. When the machine is not in action, the paraffine hardens, and does not run and drip as the oil in general use; as soon as the engine is set to work, the heat evolved will render it sufficiently fluid.

Ethylaniline Green.—J. Keisser, of Lyons, has prepared from ethylaniline a green, which is considered to be a salt of picric acid. He dissolves Hofmann's blue in three parts of spirit, and adds to it half its quantity of iodide of ethyl. After heating for half an hour in a closed vessel, one or two parts of caustic potash are added, the whole being heated for two or three hours. The pasty residue which is produced being triethylrosaniline, is carefully washed, and the iodine is recovered from the wash water. The residue is then boiled with four or five hundred parts of water, in which it is dissolved. It is then mixed with a concentrated solution of picric acid. After standing for twenty-four hours, a green substance will crystallize out, which can be used as a dye in the same manner as other aniline colours.

Manufacturing Extract and Essence of Hops.—Theophile Auguste Breithaupt of Paris has invented a process for this purpose. The hop extract is a dark brownish product which may present itself under three forms; first dry and pulverulent, second soft and thick, third liquid: it has a bitter taste, is partly soluble in hot water, and partly in alcohol, and serves to give the bitter taste to beers. It is preferable, as being cheaper, to crystals (the other form in which the bitter principle of the hops might be presented to the brewer). The essence of hops is a volatile liquid of a clear green or yellowish colour, soluble in alcohol, and serving to give the aroma to all kinds of beer when used in their

manufacture, either before or after fermentation. These two products are extracted from the cultivated or from the wild hop. The first is contained in various parts of the plant, especially in the follicles of the bind and in the pollen; the second, that is the essence, is contained only in the pollen. These products therefore contain in a very small bulk, the active principle of the plant, they keep perfectly well, and may therefore be prepared in seasons when hops are plentiful. In carriage and packing the hop loses much of its pollen, and two-thirds of its essence by dessication. M. Breithaupt operates directly on the fresh plant, in order to get out the greatest possible quantity of extract as well as essence. The essential oil is brought out by distillation in a steam bath and collected in a Florentine receiver. The extract is prepared by displacement, first in boiling water, and afterwards in alcohol, and by evaporating the charged liquids to dryness; after filtration the alcohol employed is recovered by distillation to serve a second time. The essence is more rapidly got out than the extract. In order to act on the fresh plant without losing time, it may be submitted firstly to distillation, and then dried to preserve it until the time when it is convenient to make the extract.

To Preserve Iron from Oxidation.—Hector Auguste Dufrené, of Paris, proposes to preserve iron from oxidation by coating its surface with brass. For this purpose he employs a salt of copper or oxide of copper which he dissolves in borax (biborate of soda). To this solution he adds a salt of zinc, and then dips the articles to be coated into the bath thus prepared, and passes an electric current through the metal and into the solution, so as to stimulate the deposit of the alloy of copper and zinc on the iron. When electricity is not employed, the iron after being well scoured can be dipped into a solution of borax, then into a bath of melted copper, either pure or alloyed with zinc or tin. These processes are applicable to steel and cast iron.

Sugar Refining.—Mr. J. H. Johnson has taken out a patent for refining sugar in the following manner. Crude sugar is first cleared of pieces of stone and such impurities, it is then reduced to a homogenous condition by passing it through rollers or by any other suitable treatment; it is then mixed in a proper vessel by machinery and moistened with water until it assumes a pasty consistence, when it is placed in a centrifugal machine, larger than is ordinarily used. The machine being set in motion the first solution is thrown off, this being derived from the sugar, dissolved by the preliminary moistening, consists of impurities, which coated the sugar, as well as of a sugar solution; after this first stage of the process, the solution is conveyed to a suitable tank; water and steam are applied by sprinkling and in jets to the sugar within the centrifugal machine, and another solution is thrown off, and is conducted to a separate tank from the first; thus the process may be continued, stage after stage, until the sugar is entirely dissolved, care

being taken to keep the different solutions separate. Of the solutions obtained, the first is the worst, the last the best. The process also applies to melado and molasses, after it has been granulated, and when it is desired to re-dissolve it.

ARCHÆOLOGIA.

Mr. Gordon M. Hills, the treasurer of the British Archæological Association, has made some interesting discoveries of Roman remains at West Hampnett, in Sussex. The church of West Hampnett is about two miles from Chichester, and stands on the side of the Roman road which led from the east gate of that city (the Roman *Regnum*) to London, and which is still the public highway to the metropolis in this part of the road. In the course of last year the church was being enlarged, and the chancel was repaired. The building had hitherto consisted of a chancel and a nave with a south aisle. No work of older date than the thirteenth century was apparent in the chancel, all the older windows of which, externally, belonged to that period. Internally, all architectural character was concealed by a modern application of battens and lath and plaster over the entire walls and window jambs. The roof was modern, and of the meanest description. The nave and south aisle were chiefly of early thirteenth century work, but the north wall of the nave had been in great part rebuilt in the fifteenth century, the door and windows being of that late date. Mr. Hills was engaged to direct the enlargement of this church, which was effected by taking down this north wall of the nave, and raising in its place an arcade for an additional north aisle. In taking down this north wall, a few pieces of Roman tile were found among the rubble work. It was in the chancel, however, that the most interesting discoveries of Roman and Saxon remains were made, and these were of very considerable importance. The chancel arch was formed a plain semicircle, without chamfer or moulding, the jambs having rude stone dressings, and the archivault being faced with modern plaster. The width of the opening was less than six feet; it was low, and yet bore appearances of a rude attempt at some period to enlarge it from some still smaller dimensions. When the modern plaster was stripped off, the arch was found to be entirely constructed of Roman tiles, taken no doubt from some earlier Roman building. Many of these tiles were perfect, but the greater number had been broken when used by the ecclesiastical builders. They were, when perfect,

of two sizes, one about eighteen inches by ten or eleven, the other twenty-two inches by fourteen, and respectively one and a half and two inches thick. Upon stripping off both the inside and outside plaster of the side walls of the church, unmistakable characteristics of Saxon work with Roman materials presented themselves. The western part of the chancel, both in its north and south walls, in rather more than half its length, was found to be built of rubble stone and flint, largely mixed with broken Roman tiles of the same kind as those used in the chancel arch, the work being in herring-bone courses. In each of these side walls a small rude Saxon window still remains, though blocked up. The head of the window in the north wall has been broken away, but like that of the other, which still remains, it was no doubt a little semicircular arch cut in one stone. Except the external heads, neither window ever had any cut stone, nor was there any provision for glazing. Internally the windows splay out to a good width, and have semicircular arches of rubble. Besides the flat Roman tiles, these side walls contain fragments of Roman roofing tiles (*imbrices*), and some fragments as well as perfect examples of Roman tiles of a very unusual description, evidently designed for some kind of arch work. Each tile is a perfect voussoir of an arch, and is hollow, as if intended for a flue-tile. Mr. Hills, however, thinks that these tiles were made hollow only to secure greater perfection in their manufacture. Among the Roman *debris* were found two pieces of marble, probably from the neighbourhood of Torquay, in Devonshire. They were small squares, which had originally been used in a pavement, and were much worn by the feet of those who had walked over it.

The chancel arch, and the whole east end of the nave in which it was placed, were evidently part of a Saxon nave, in form a simple parallelogram, and the Saxon side walls of the present chancel indicated the extent of the Saxon chancel. In the thirteenth century, the east end of the Saxon chancel was taken down, the chancel was increased in length, the new work being totally different in character from the older part, but the material of the east Saxon wall, with its Roman *debris*, was used in the lower part of the extension of the north wall. Four lancet windows were inserted in the old Saxon work, and a fifth, with an elegant piscina underneath, was introduced in the extension of the south wall. The new east end was furnished with a good window of two lancets, with a quatrefoil in the tympanum of the arch which coupled the lancets together.

In the restoration of the chancel, which has now been effected, the whole of the ancient work, whether Roman, Saxon, or of the

thirteenth century, has been preserved, and left open to view, with the exception of the chancel arch, which has been necessarily enlarged.

In laying these discoveries before the British Archæological Association, at one of its recent meetings, Mr. Hills remarked that the CHURCH OF RUMBOLDSWYKE, about a mile distant from West Hampnett, was undoubtedly Saxon, and had Roman tiles in herring-bone courses in the east end of the nave. The county of Sussex is remarkable for the number of its Anglo-Saxon ecclesiastical remains, the preservation of which we probably owe to the respect which its population cherished towards Wilfred, who converted them to Christianity in the latter part of the seventh century. Mr. Hills considers that the church of East Lavant, about a mile and a half from West Hampnett, in another direction, though free from Roman remains, is also a Saxon church.

T. W.

LITERARY NOTICES.

PHYSICAL, HISTORICAL, AND MILITARY GEOGRAPHY. From the French of Th. Lavallée, late Professor of Military History and Statistics at the Military School of St. Cyr. Edited, with additions and corrections, by Captain Lendy, F.G.S., F.L.S., Director of the Practical Military College at Sunbury. (Stanford.)—The old plan of teaching geography, as a tiresome catalogue of places, latitudes, longitudes, etc., no doubt lingers in thousands of bad schools, but has long been exploded in good ones. To Humboldt, Ritter, and Steffens belong the chief merit of creating a science of physical geography; and it is too much for Mr. Lendy to say that in 1836 Lavallée opened a new era in its study. The edition of Lavallée's work which he now brings before the public in an English guise, is, however, a very useful book, and would have been more so if the translator had been more careful to correct its errors, and bring it down to date.

In the first page, the mean distance of the sun from the earth is given as ninety-five millions of miles, though well-known recent determinations make it less. The second paragraph contains exploded notions which no "F.G.S." should have passed in silence. Lavallée states that the earth "may be said to be divided into two parts, the central nucleus or interior part, whose radius is probably upwards of 3480 miles," and the "external crust or superficial part, which has a variable thickness of not more than twelve to twenty-four miles." The interior part, we are then told, "the most recent researches have almost demonstrated to be composed of

incandescent matters." How Captain Lendy, with any pretensions to acquaintance with recent science, can have allowed this totally erroneous assertion to stand we cannot conceive. Recent researches, from those of Hopkins downwards, have all concurred in showing that our earth cannot possibly be a thin bottle containing an immense body of incandescent matter. The "facts" adduced in proof of the exploded theory are, first, "the density of the earth, which is so great, that its interior must consist of very much heavier matters than those composing the external crust." Now it is absurd to assume the incandescence of the interior part from the necessity of its containing heavy matters; and it is illogical to add, as a second "proof," the assertion of the existence of a "central heat proper to the earth." Such heat may exist, but it is not positively known, or positively evidenced by the fact that temperature augments in the course of the trifling distances to which man has descended. The third "proof" of central incandescence is drawn from volcanic phenomena, which Mallet's researches have shown not to be very deeply seated.

In another paragraph we are told that the exploration of the substances composing a mountain 24,000 feet high, is equivalent to that of a plane to the depth of 2400 feet. This could only be true if the plane strata were all horizontal, and the mountain was formed by the elevation of a mass of strata, 24,000 feet thick, with a perfect preservation of their horizontal position. M. Lavallée affirms that the "whole crust of the earth shows marks of sudden and numerous revolutions." Mr. Lendy has modified this in a note, but he has omitted to correct the serious error of representing all the so-called "primary rocks" of the older geologists as having "resulted from the first solidification of the earth." There is no reason whatever for supposing that any human being has seen a particle of matter in the state left by the earth's first solidification, and igneous rocks belong to a variety of dates. This geological chapter does not contain a single paragraph that represents the existing state of science. It should have been entirely re-written or left out. The chapter on physical geography is very unsatisfactory. Mountains are divided, according to their heights, into four orders, and they are arbitrarily stated to have four, three, and two regions. Those, for example, which are from four to nine thousand feet high, "contain," we are told, "only three regions, cultivated, forest, and pasturage," while those which are at least 11,500 feet, have "four regions," the three just mentioned, and one of perpetual snow; and those less than 4000 feet, have only two regions, cultivated and forest." Now it would be impossible to crowd more errors into a few lines. Turning to the work of a cautious writer, Prof. Ansted,* we find the limits of perpetual snow in the Andes of Peru stated to be 18,000 feet, while in the Straits of Magellan it is only 3,390 feet, and close to the Arctic ocean 2,000 feet. In another passage we are informed

* "Physical Geography."

that "in high mountains, spaces are met with where there is permanent congelation: these are glaciers." It is certainly not a sound definition of a glacier to call it "a space of permanent congelation," nor is it true that glaciers are always found where permanent congelation exists.

Following the chapter on physical geography, is one on "Man considered by Himself," and another on "Man considered Socially," neither of which can be commended. In the latter we are informed that "the *revenue* of a State is the sum of the *taxes* required to liquidate its expenses," a doctrine which would be fatal to even the possible existence of a national debt.

The parts we have criticised bear a very small proportion to the whole work, but we fear they will materially restrict its use, though it would be well to consider them omitted, and to regard the treatise as commencing where they end. The useful part of the work begins at p. 58, with the description of the Spanish region, then follow the French region, the German region, the Italian region, the Greek region, the British region, after which came descriptions of Asiatic, African, and American regions. These are in the main very well done, and upon a plan likely to be very useful to military men. As a whole, we must speak of this book favourably, and our objections to its early chapters must not be regarded as involving any general condemnation. If those chapters interfere, as we expect they may, with its introduction into schools, the general merits of the book would make it desirable to arrange a fresh issue in which they might be entirely recast.

A School Manual of Health. Being an Introduction to the Elementary Principles of Physiology. By Edwin Lankester, M.D., F.R.S. (Groombridge and Sons.)—Dr. Lankester has in this small, nicely printed, and cheap volume, supplied a work adapted to "the elder scholars in national and other schools." It consists of seven chapters, beginning with the Constitution of the Human Body; then treating of Food, Digestion, Respiration, Structure and Functions of the Skin, the Movements of the Human Body, the Brain, Nerves, and the Organs of the Senses. Used, as Dr. Lankester recommends, with the large diagrams he mentions, it would prove an efficient and interesting class book, and the subjects of which it treats, ought most assuredly to be generally taught.

Half-hours with the Telescope; being a Popular Guide to the Use of the Telescope as a means of Amusement and Instruction. By Richard A. Proctor, M.A., F.R.S., with illustrations on stone and wood. (Hardwicke.)—Mr. Proctor's handy and cheap little volume is addressed to a class of observers wanting more elementary aid than those for whom Mr. Webb has so ably provided. After a preliminary chapter on the construction of telescopes, the constellations are arranged in groups, which can be conveniently examined at the same time of the year, or on the same evening. Several well-designed maps are supplied to assist in

recognizing the various objects, and numerous illustrations are given of double stars and nebulæ, the angles of position of the former being indicated by arrows representing the apparent paths of the stars across the field of the telescope. Following the star portion of the book, come half-hours with the planets, with two plates, one giving elaborate details of the various aspects of Mars, besides diagrams of Venus and Mercury. Half-hours with the Sun and Moon wind up the work. All through we notice evidence of Mr. Proctor's skill in condensing information, and making difficult matters intelligible. At p. 78, for example, is an ingenious method of finding Mercury by means of crossed sticks easily set up.

Recollections of the Paris Exhibition of 1867. By Eugene Rimmel, Member of the Society of Arts, the Royal Horticultural Society, the Nice Horticultural Society; Juror and Reporter, Exhibition, 1862; Assistant Commissioner, Exhibition, 1867; Author of the "Book of Perfume," etc. (Chapman and Hall.)—A series of articles on the French Exhibition, written by Mr. Rimmel for the "Courier de l'Europe" and the "Patrie," richly illustrated by engravings from the "Art Journal," and now translated into English, makes a very elegant and useful *souvenir* of the great show at Paris. As a book for the drawing-room table, and supplying a valuable collection of ornamental designs, this pretty work cannot fail to be appreciated. Mr. Rimmel's remarks on the various objects indicate fairness, and good taste.

Summary Notes on Vegetable Anatomy and Physiology, and the Classification of British Plants. By Louis C. Miall, Curator to the Philosophical Society, Bradford. (Simkin, Marshall, and Co.)—This is a thin pamphlet with four plates, in which the author has endeavoured to compress a great deal of matter. A little publication of the kind would, we apprehend, be most useful to a class taught, according to a method which it would illustrate. For private study it seem too meagre to be satisfactory.

On the Principles of Grammar. By the Rev. E. Thring, M.A., Head Master of Uppingham School, Oxford. (Clarendon Press, Macmillan and Co.)—In the hands of a good teacher, this grammar would be an efficient instrument of instruction. The illustrations from various writers would easily make the study interesting, instead of being, as it usually is, a bore to young people, and the explanations are lucidly given.

Practical Water-Farming. By William Peard, M.D., LL.B. (Edmonstone and Douglas.)—Dr. Peard has written a pleasant book on the artificial culture of fish, lobsters, crabs, etc. He is very sanguine of the commercial success of water-farming, and in addition to descriptions of well-known experiments, he adduces many others to which little or no attention has hitherto been paid. It is certainly strange that this country should have so long neglected sources of profit which the Dutch, Italians, French, and Germans devote much attention to. The high price of

butcher's meat, and the increase of population, renders it highly important to make the most we can of water-farming, and Ireland offers many facilities for the work. Dr. Peard would turn all sorts of localities to account, and he contends that where clay exists for puddling, three acres of poor land converted into ponds may be made to yield £200 per annum in pike, perch, and eels.

A KEY CONTAINING ANSWERS TO THE EXERCISES IN GALLOWAY'S FIRST STEP IN CHEMISTRY. (Churchill.)—Students using Galloway's "First Step in Chemistry" will be glad to know that this key to its questions is published in a convenient form. It contains seventy-eight pages of well-arranged matter.

BIBLE ANIMALS: An Account of the various Birds, Beasts, Fishes, and other Animals mentioned in the Holy Scriptures. By the Rev. J. G. Wood, M.A., F.L.S., Author of "Homes without Hands," etc., copiously illustrated with new and original designs, made under the author's superintendence, by F. W. Keyl, T. W. Wood, and E. A. Smith, and engraved on wood by George Pearson. (Longmans.)—This popular and deserving work maintains the interest of its earlier numbers. It is an excellent family book, and will be in constant requisition amongst Bible readers of all ages.

THE RUDIMENTS OF MINERALOGY: a Concise View of the General Properties of Minerals. By Alexander Ramsay, junior, with Copious Index. (Virtue and Co.)—This seems to be a useful compilation of 330 pages. The author states that it is chiefly founded on Rammelsberg's "Mineralchemie," De la Fosse's "Mineralogie," Bischof's "Chemical and Physical Geology," and Der Cloiseaux's "Mineralogie." The arrangement of the minerals resembles that of the British Museum Collections, the new atomic weights are employed, and the water specific gravities reduced to the hydrogen scale. So far as we can judge from a cursory inspection, this book will be found a compact and convenient guide to its subject.

Amongst miscellaneous books on our table, we may mention with commendation, the "Photographs of Eminent Medical Men," which Mr. Churchill is bringing out in a series of parts, and which continues to deserve the commendations bestowed upon earlier portions.

NOTES AND MEMORANDA.

A NEW EXPERIMENT IN PHYSICS.—M. Kommerell describes in Poggend. Annalen, the following experiment. A pulley wheel is made of a very short cylinder, having at each end glass disks of equal size, but much larger than the cylinder. A ribbon is wound round the disk several times, detaching itself tangentially on the under side. If this pulley-wheel is drawn up an inclined plane, not too steep, by means of the ribbon; it will be found that the wheel revolves and rolls itself up the ribbon. The friction of the wheel against the inclined plane is the cause of this curious action.

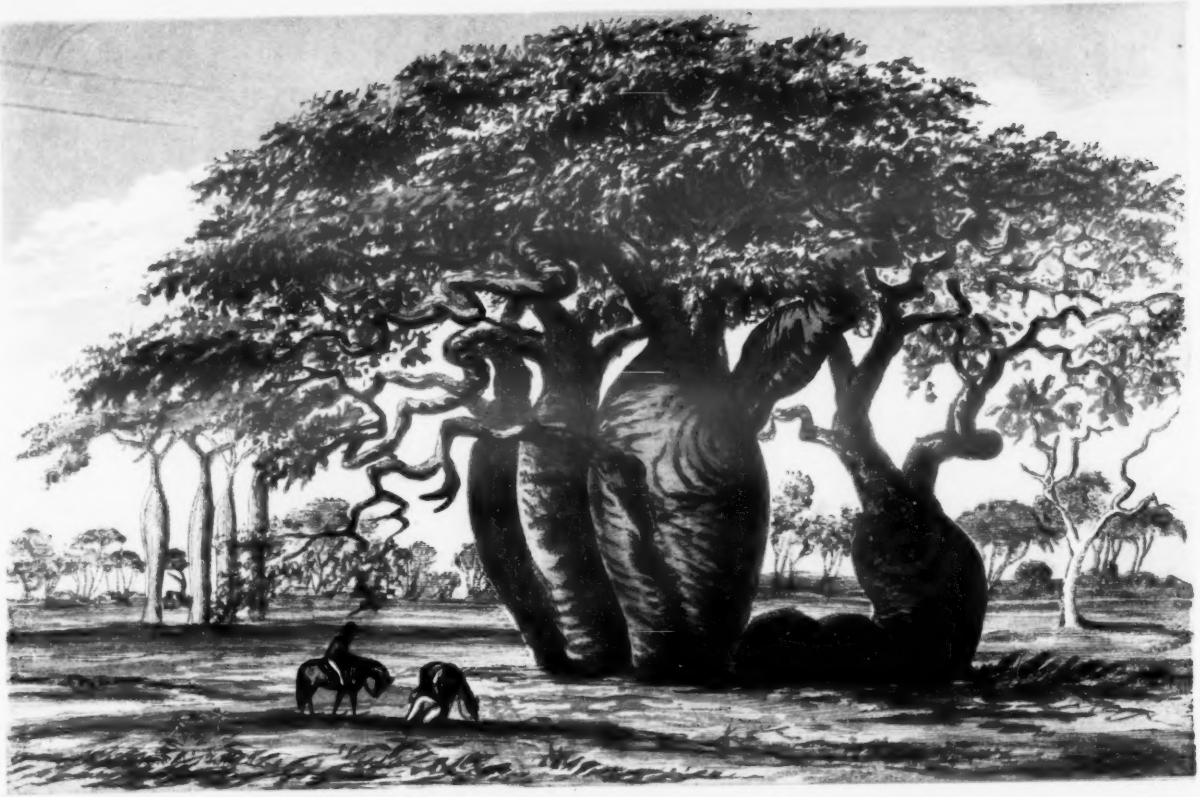
MENTAL DEVELOPMENT.—Mr. Kingdon Clifford recently delivered a clever lecture at the Royal Institution on the above subject, in which he said, "to become crystallized, fixed in opinion and mode of thought, is to lose the great characteristic of life by which it is distinguished from inanimate nature. . . . . Propriety is the crystallization of a race. . . . . It is quite possible for conventional rules of action and conventional habits of thought to get such power that progress is impossible, and the nation only fit to be improved away."

THE COAL QUESTION.—Professor Stanley Jevons in a lecture at the Royal Institution, points out that economy in the employment of coal tends to increase the total quantity consumed, by making its use more advantageous or more profitable. In 1866 our yield of coal was more than a hundred millions of tons. He thinks that within a hundred years the exhaustion of our mines will manifest itself, not in stoppage of supplies but increase of cost, and impossibility of increasing consumption as at present. We may then stand in a position of inferiority to other countries whose coal supplies are more accessible.

ANTIQUITY OF MAN.—M. Laussedat calls the attention of the French Academy to fragments of rhinoceros jaws, found at Billy (Allier), which appears to have been cut with a tool. M. Lartet identifies this rhinoceros with the *R. pleuroceros* of Duvernay, which lived on the banks of the miocene lakes of Central France.

MOULDS IN SILICA SOLUTIONS AND THEIR FOSSILIZATION.—At the May meeting of the Royal Microscopical Society a paper by Mr. William Chandler Roberts, F.C.S., and Mr. Slack, Sec. R.M.S., was read, describing the readiness with which moulds or mildews grow in dialysed solutions of pure silica in distilled water. As the silica gelatinizes and consolidates, these moulds are exquisitely preserved as if by natural fossilization. Mr. Roberts noticed beautiful arborescent forms in artificial minerals, made by allowing colloid silica to solidify slowly, and observed their vegetative aspect, though it seemed probable they were of mineral origin. Mr. Slack thought them artificial fossils of moulds, and instituted a series of experiments to show that moulds would grow freely in solutions of silica, and could be artificially fossilized. Mr. Barff, F.C.S., also made some interesting experiments on the subject, and considered that sufficient attention had not been paid to the function performed by silica in the growth of plants. The authors of the paper commented on the curious fact that after the arborescent moulds were enclosed in gelatinized silica its further contraction into a firm solid did not cause any corresponding squeezing together of their several parts. Mr. Roberts found these artificial minerals to contain more than 20 per cent. of water.

FOSSIL INSECTS OF NORTH AMERICA.—The "Geological Magazine" has published an interesting account of the fossil insects of North America, written by Mr. Samuel H. Scudder. Of eighty-seven species he mentions, six are Devonian, fifteen Carboniferous, one Triassic, and sixty-five Tertiary. Ten are Coleopterous, viz., one Triassic, and nine Tertiary; four Orthoptera, all Carboniferous; nine Nemoptera, viz., six Devonian, and three Carboniferous; three Hymenoptera, forty-five Diptera, and six Hemiptera, all from the Tertiaries; three are Lepidoptera, one doubtful Carboniferous, and two Tertiary, of which one is doubtful; two are Myriopoda, both Carboniferous, but one of doubtful character. No spiders have yet been found fossil in North America.



GROUP OF BOTTLE-STEM TREES,

Adansonia Gregorii, near the Baines River, Victoria River, North Australia.

From an original oil-painting by T. Baines, in the Museum, Kew.

GROUP OF GOUTY-STEM TREES,

Adansonia Gregorii, near the Baines River, Victoria River, North Australia.

From an original oil-painting by T. Baines in the Museum, Kew.